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(54) **WIRELESS EARBUD CHARGING**

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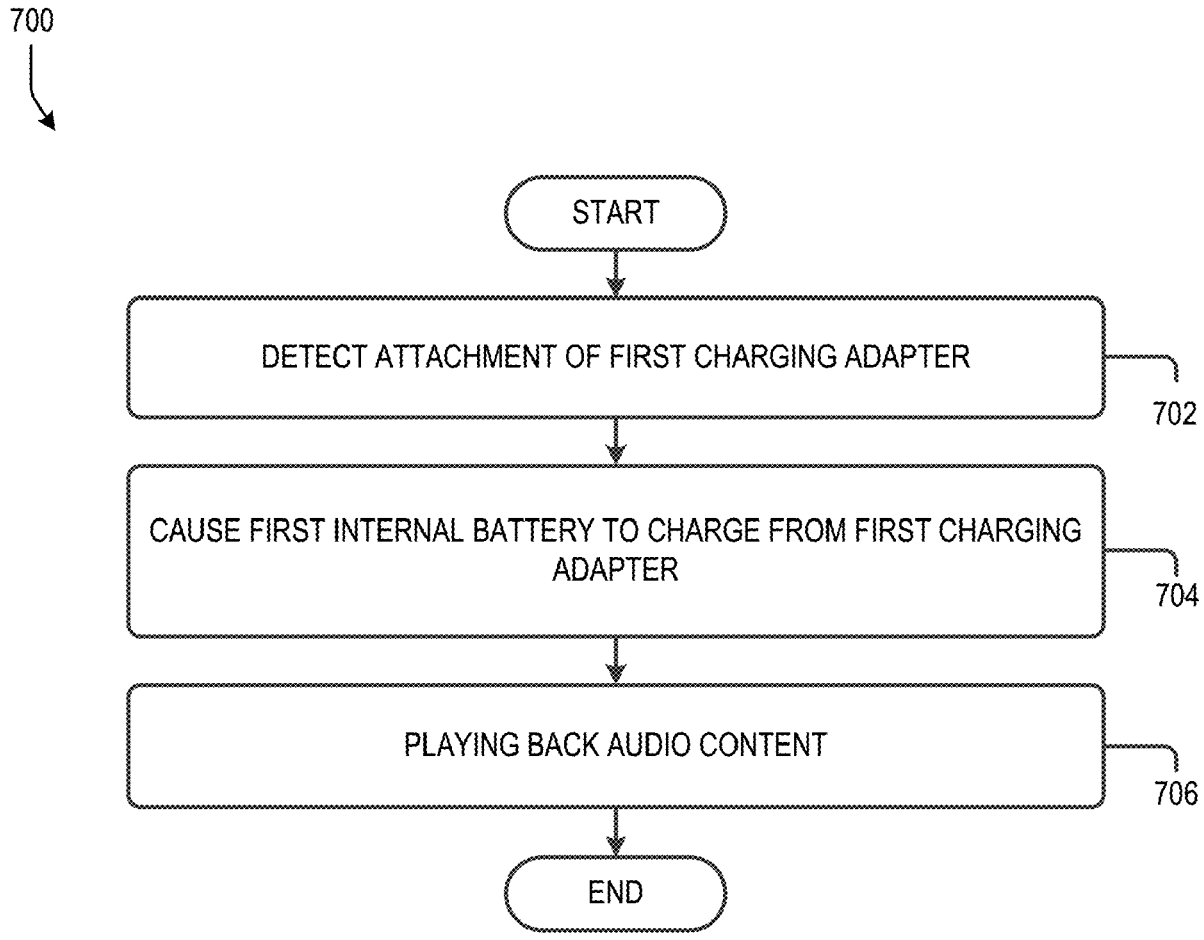
H04R 5/033	(2006.01)
H02J 50/12	(2006.01)

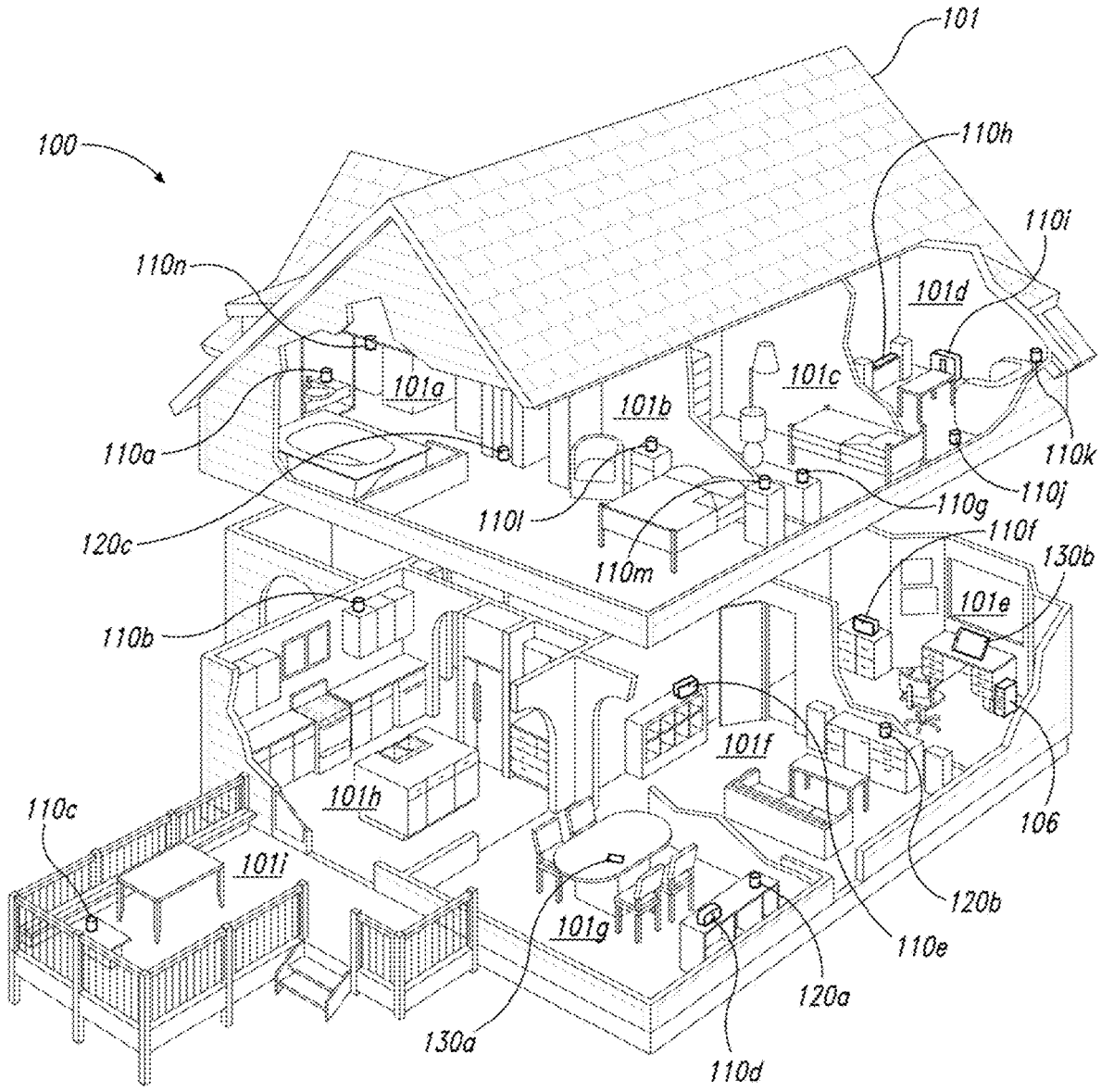
(52) **U.S. Cl.**

CPC ***H04R 1/1025*** (2013.01); ***H04R 5/04*** (2013.01); *H04R 2420/07* (2013.01); ***H02J 50/12*** (2016.02); ***H04R 5/033*** (2013.01)

(57) **ABSTRACT**

Examples described herein relate to a charging system for wireless earbuds involving charging adapters that are attachable to the wireless earbuds. In some implementations, the charging adapter is attachable to an external surface of an earbud using a magnetic or mechanical interface that align electrodes of the charging adapter with electrodes on the wireless headset, allowing an internal battery of the earbud to draw current and charge from the charging adapter while the earbud is in-ear. Then, when the internal battery is and recharged using a charging case or wall charger, the charging adapter can be detached from the earbud.

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110e
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130a
110d

Fig. 1A

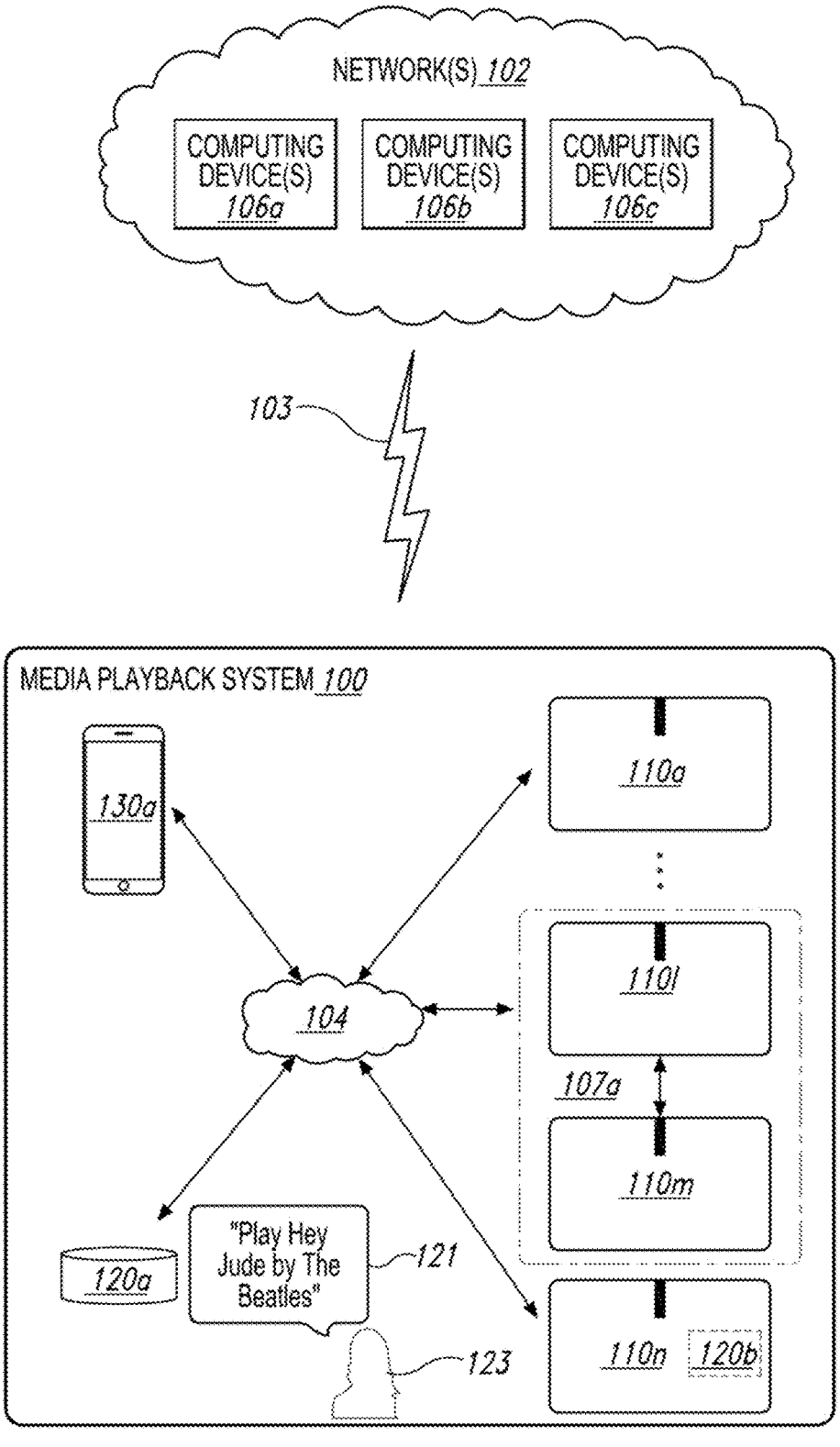

NETWORK(S) 102
COMPUTING DEVICE(S) 106a
COMPUTING DEVICE(S) 106b
COMPUTING DEVICE(S) 106c
103
MEDIA PLAYBACK SYSTEM 100
130a
110a
110l
104
107a
110m
"Play Hey Jude by The Beatles"
121
120a
123
110n
120b

Fig. 1B

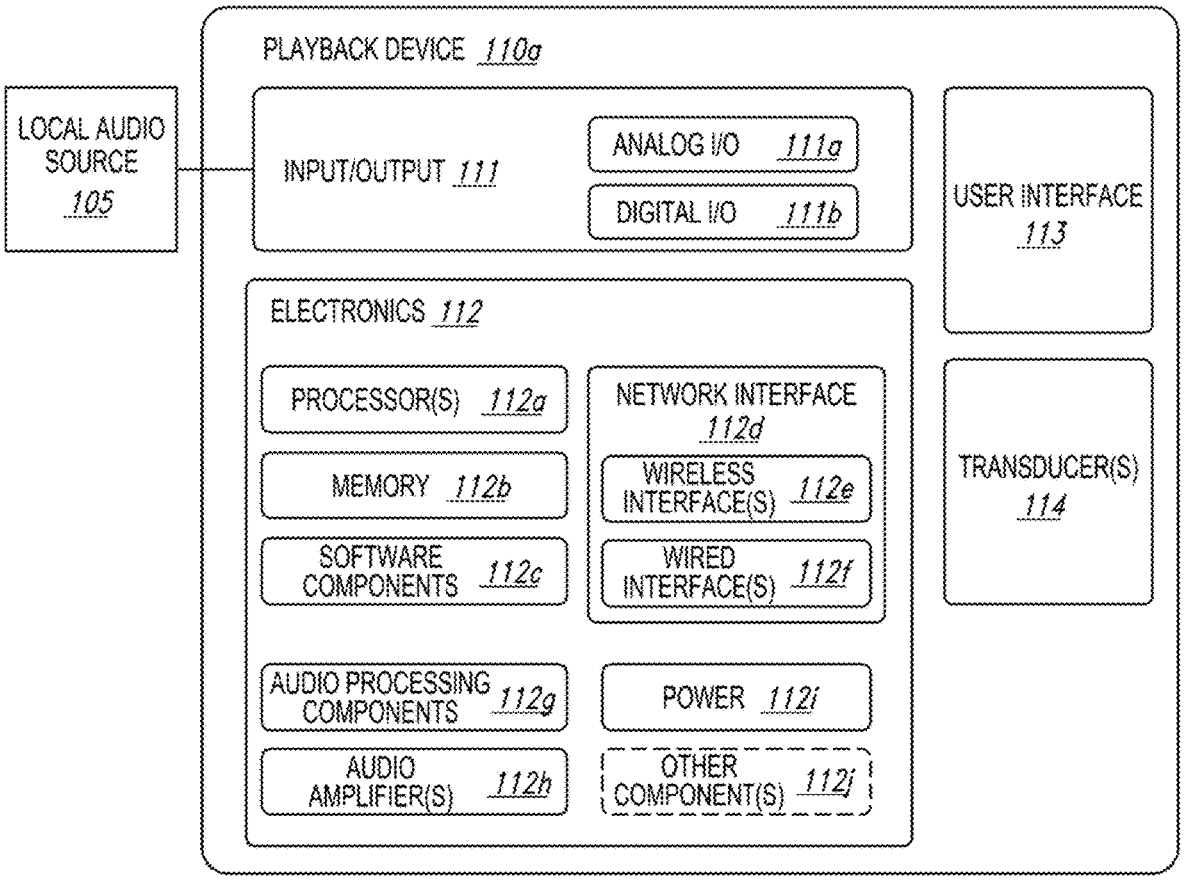


Fig. 1C

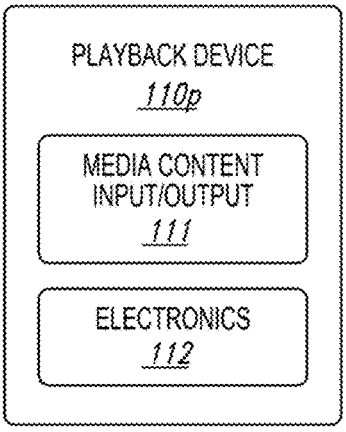


Fig. 1D

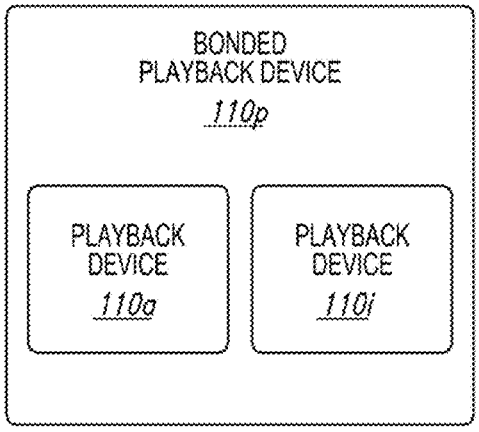


Fig. 1E

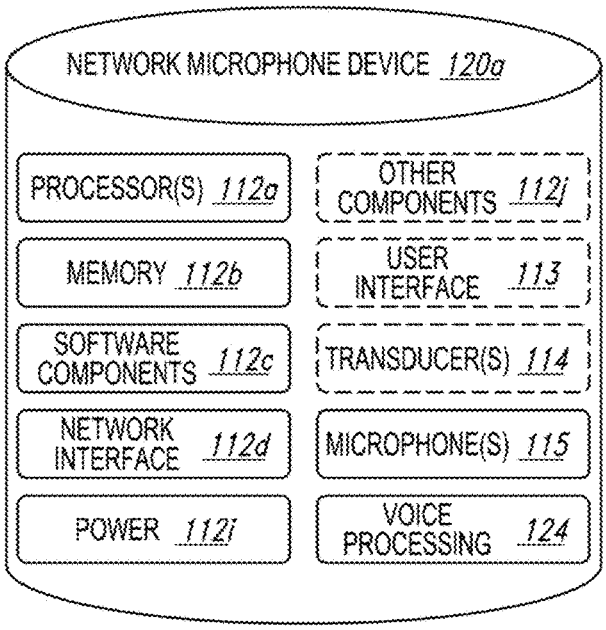


Fig. 1F

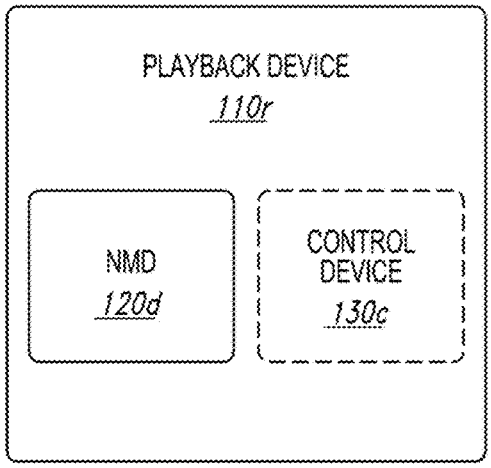


Fig. 1G

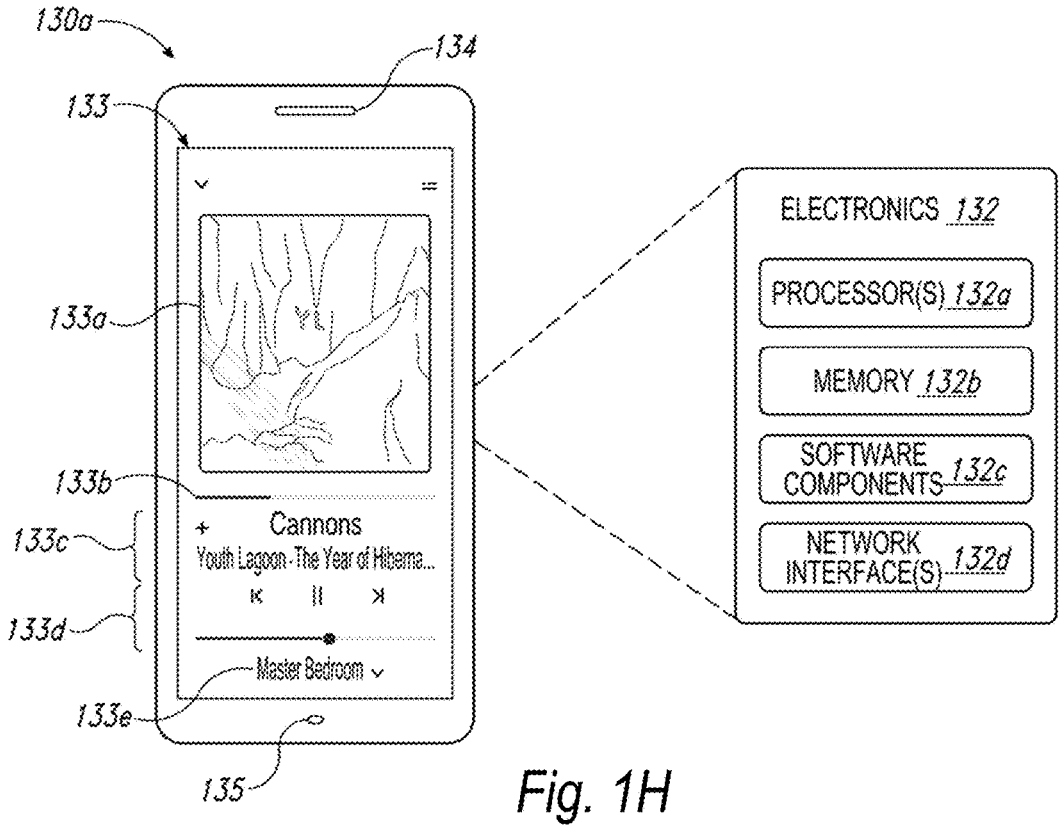
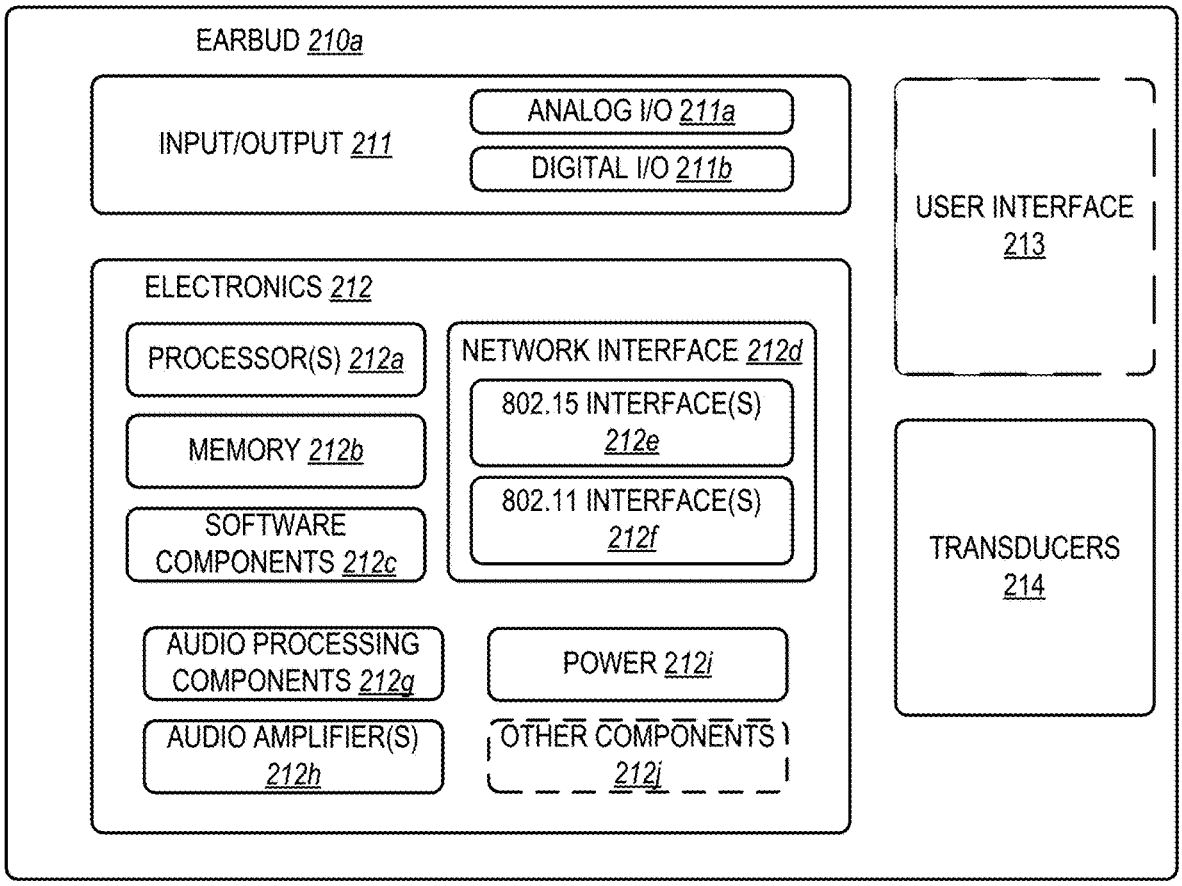


Fig. 1H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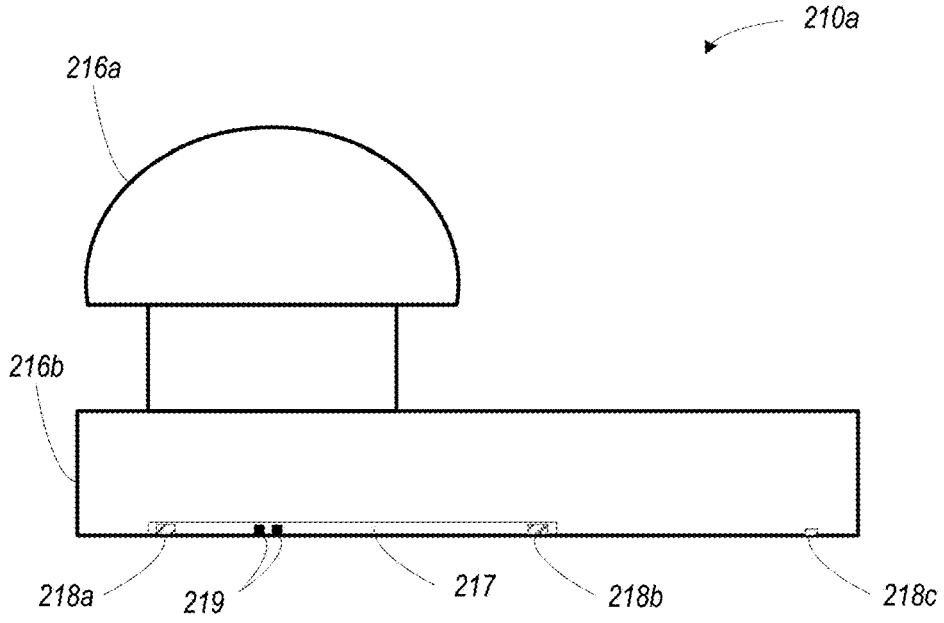
INPUT/OUTPUT 211
ANALOG I/O 211a
DIGITAL I/O 211b
USER INTERFACE 213
ELECTRONICS 212
PROCESSOR(S) 212a
MEMORY 212b
SOFTWARE COMPONENTS 212c
NETWORK INTERFACE 212d
802.15 INTERFACE(S) 212e
802.11 INTERFACE(S) 212f
TRANSDUCERS 214
AUDIO PROCESSING COMPONENTS 212g
POWER 212i
AUDIO AMPLIFIER(S) 212h
OTHER COMPONENTS 212j

Fig. 2A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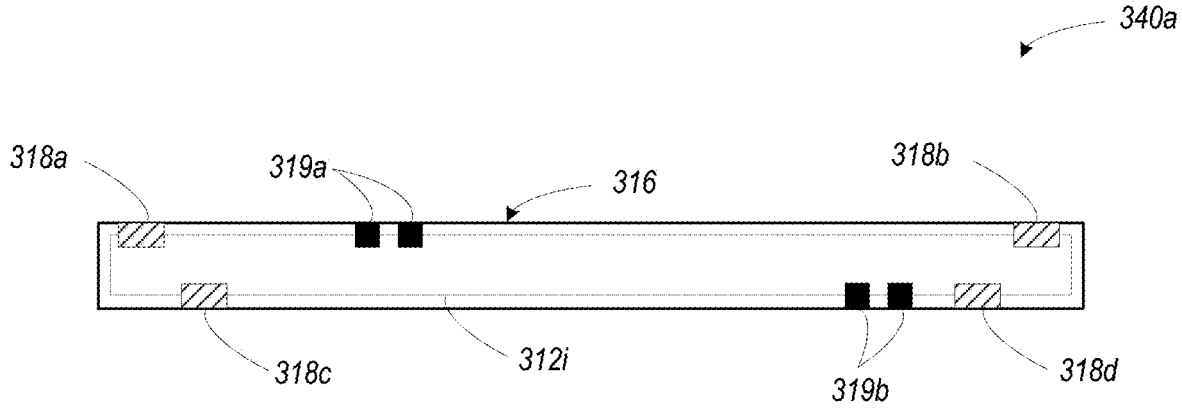
218b
218c

Fig. 2B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318a
319a
316
318b
318c
312i
319b
318d

Fig. 3A

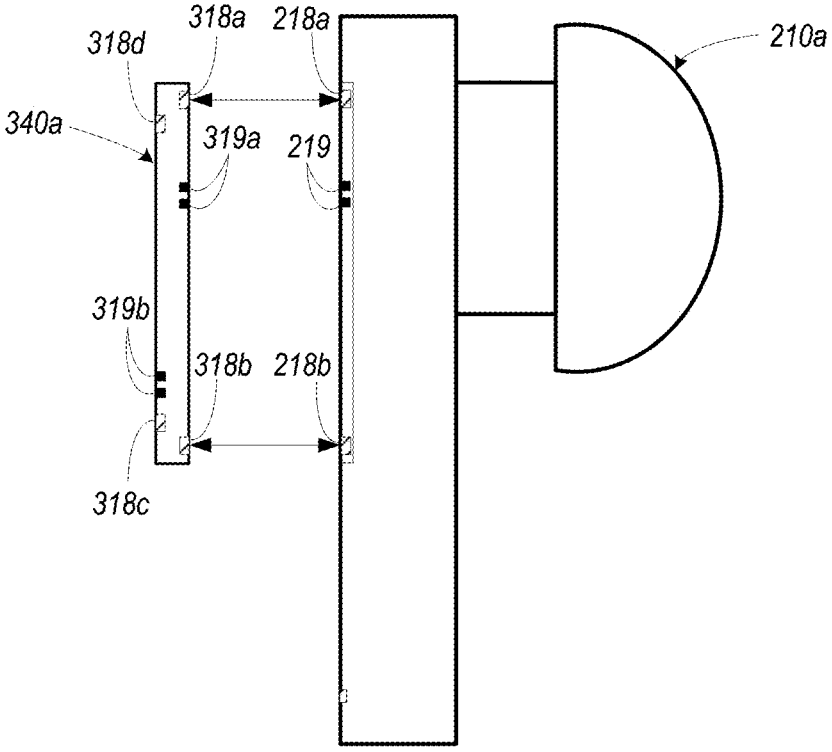
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Fig. 3B

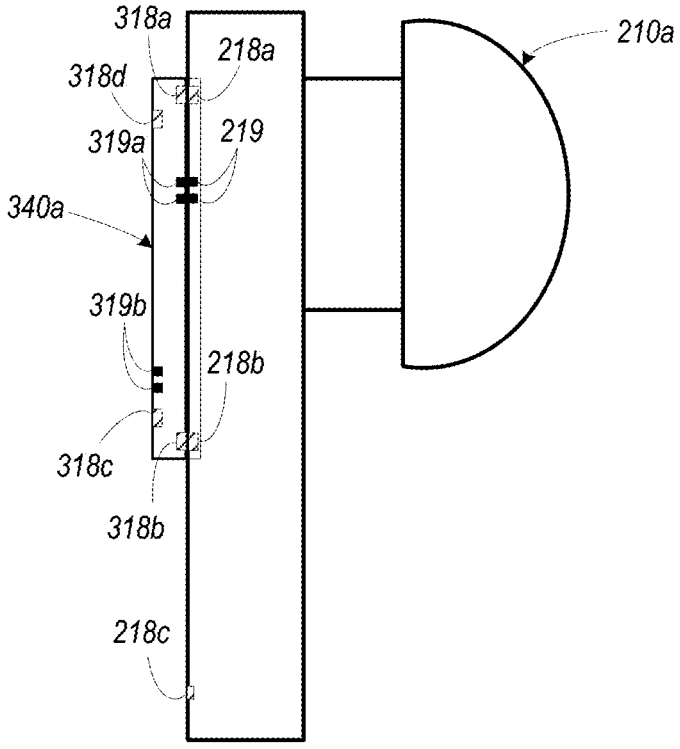


Fig. 3C

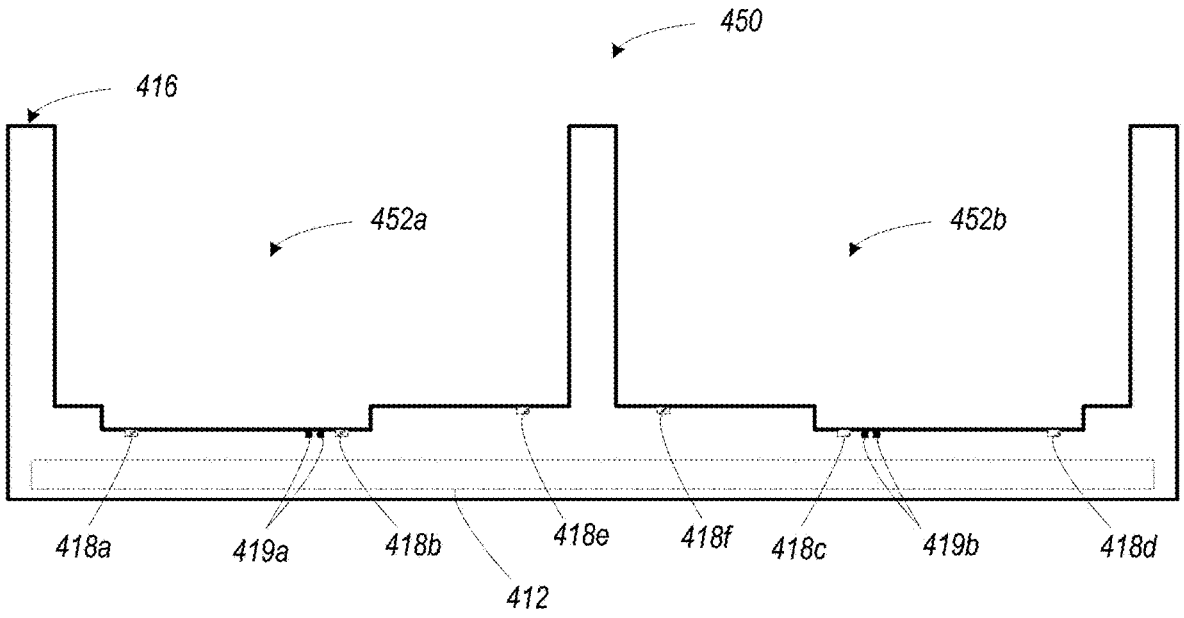
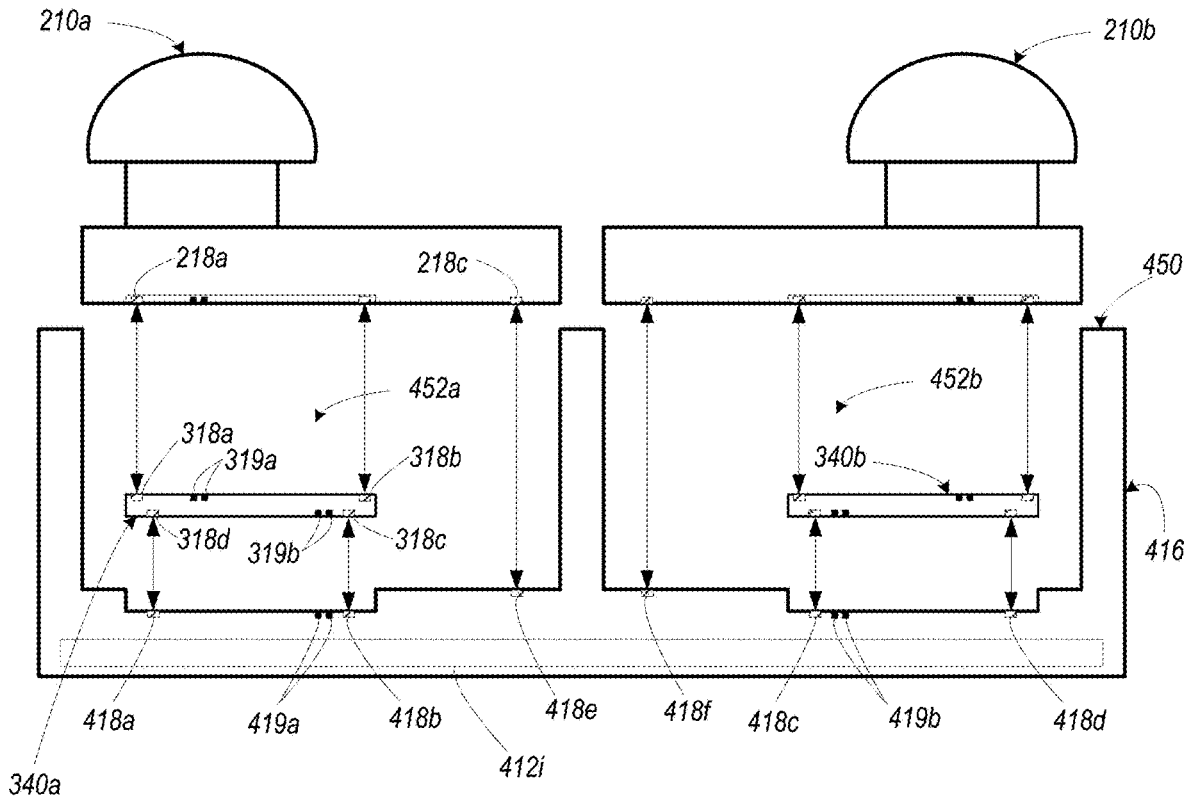


Fig. 4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412i
340a

Fig. 5A

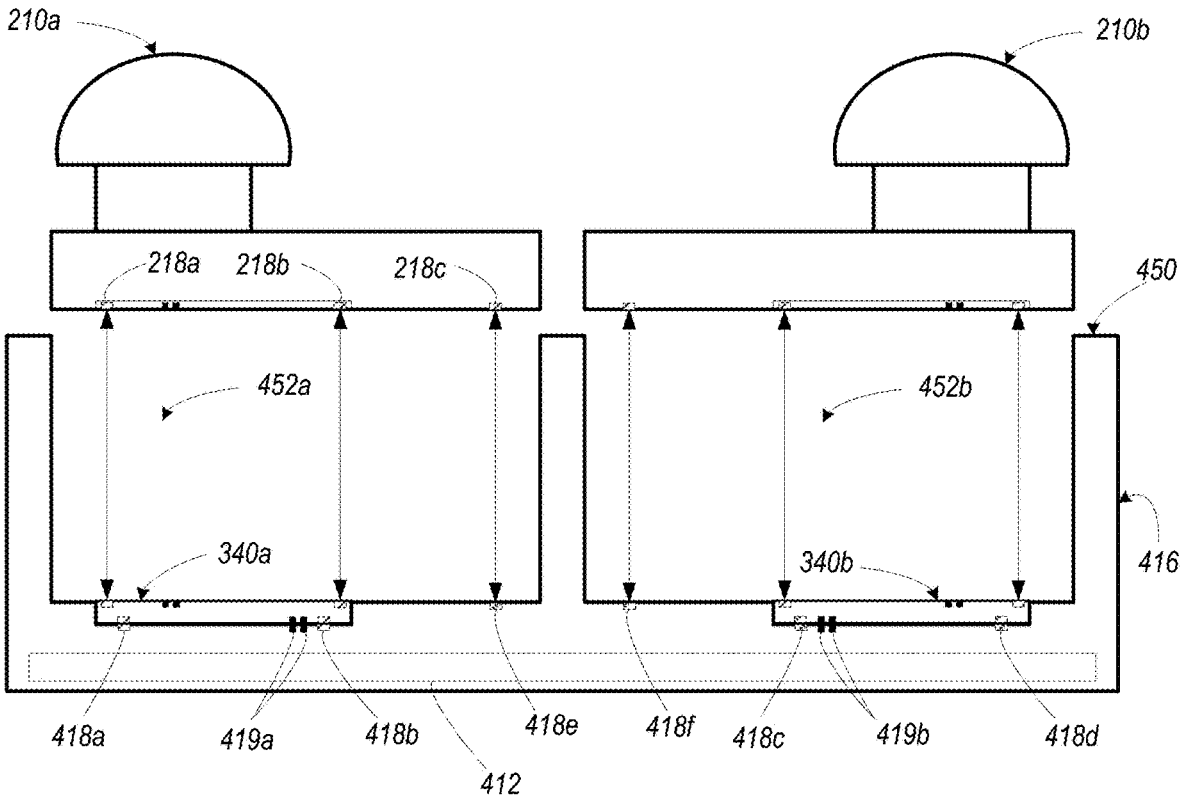
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Fig. 5B

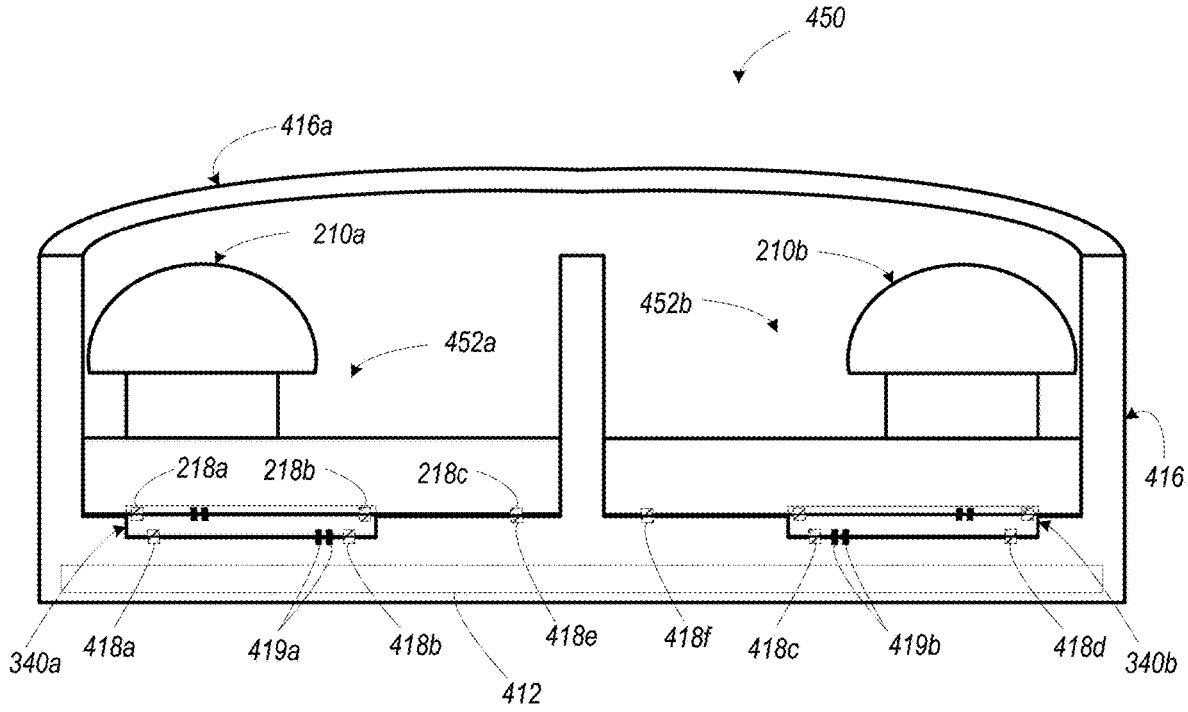
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Fig. 5C

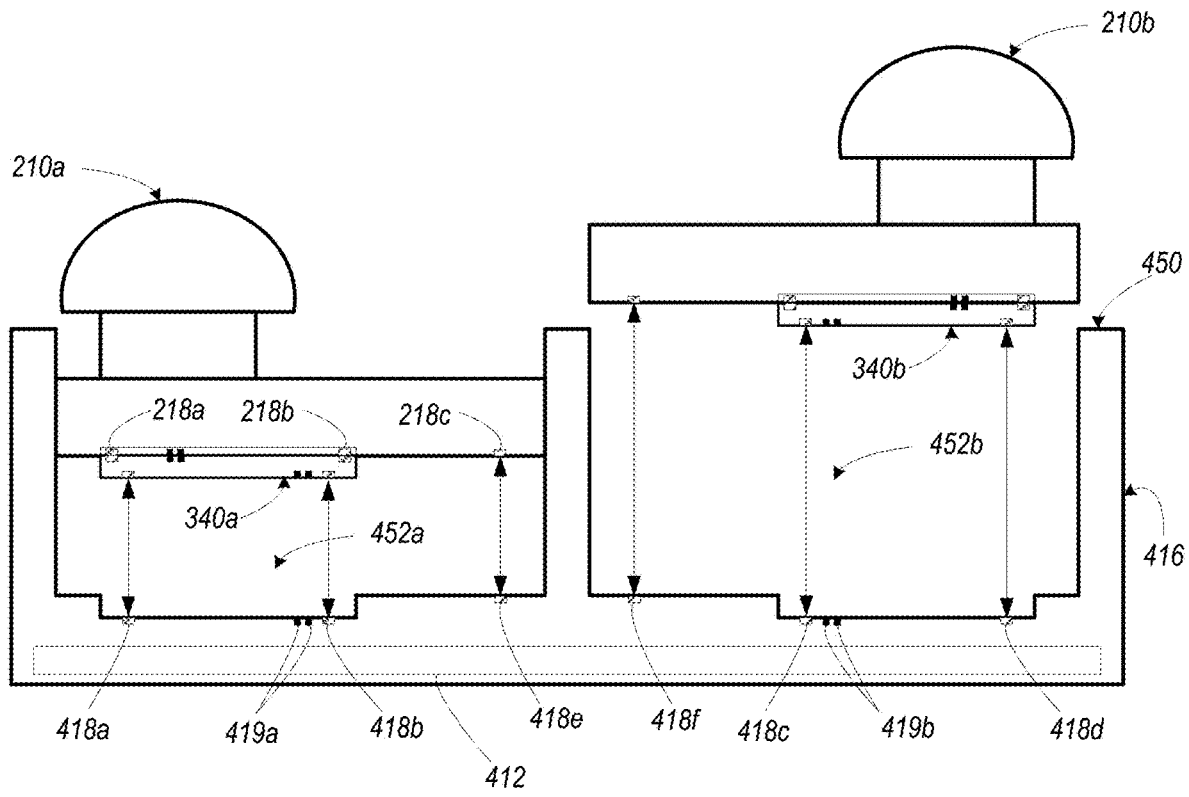
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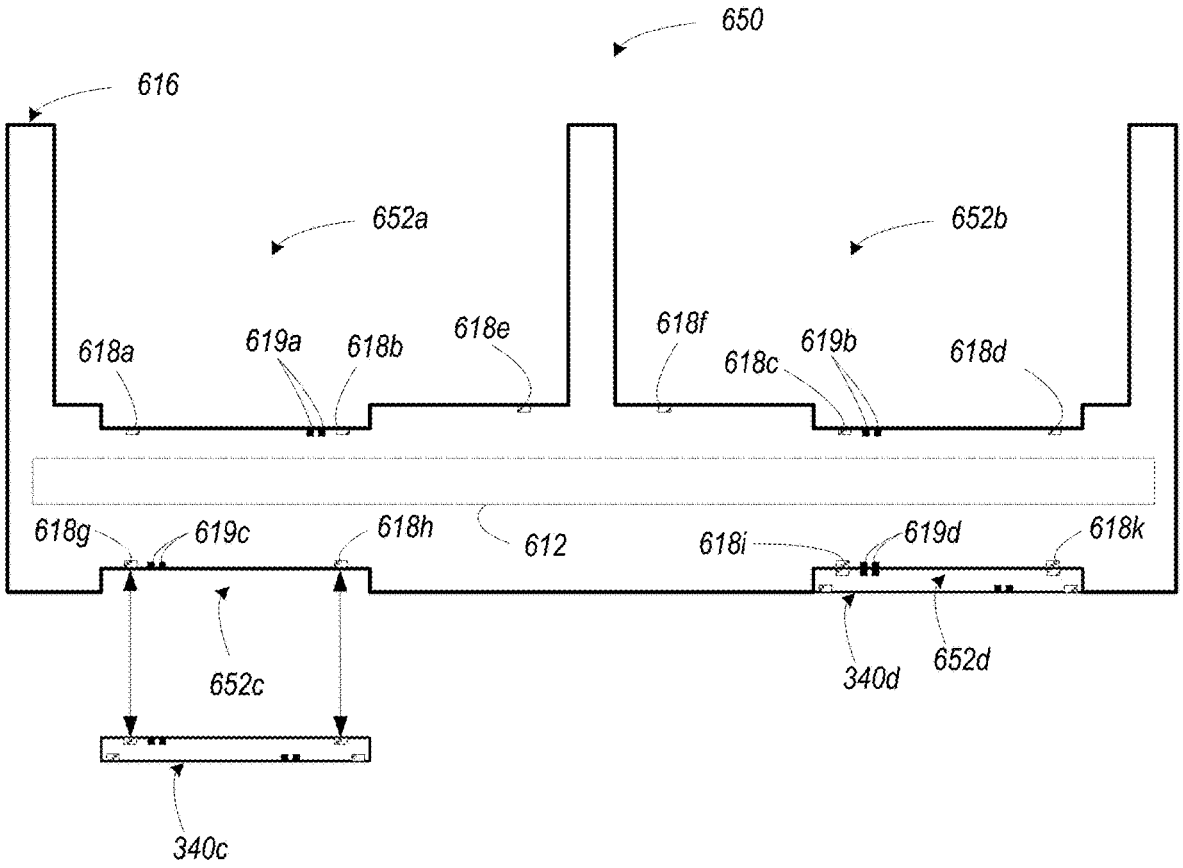
Fig. 5D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618k
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340d
652d
340c

Fig. 6A

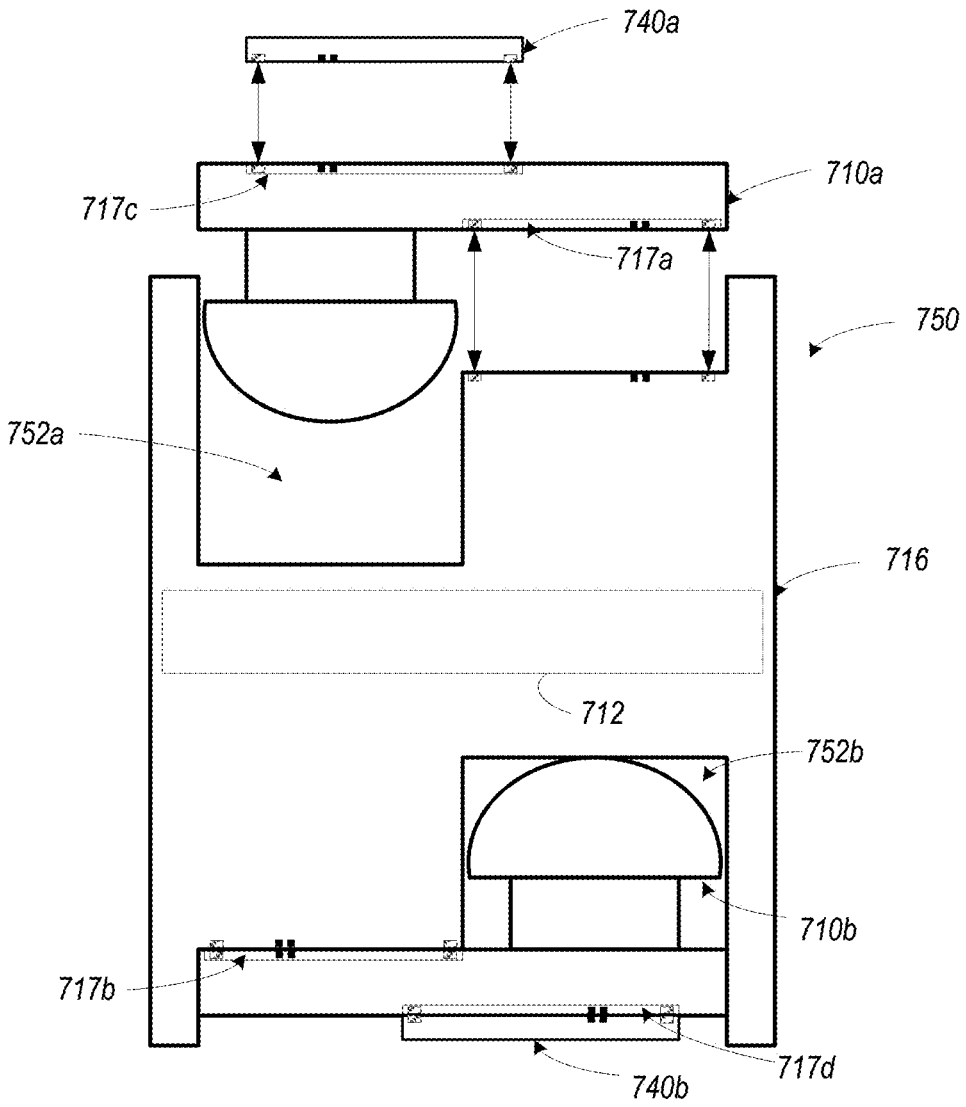


Fig. 6B

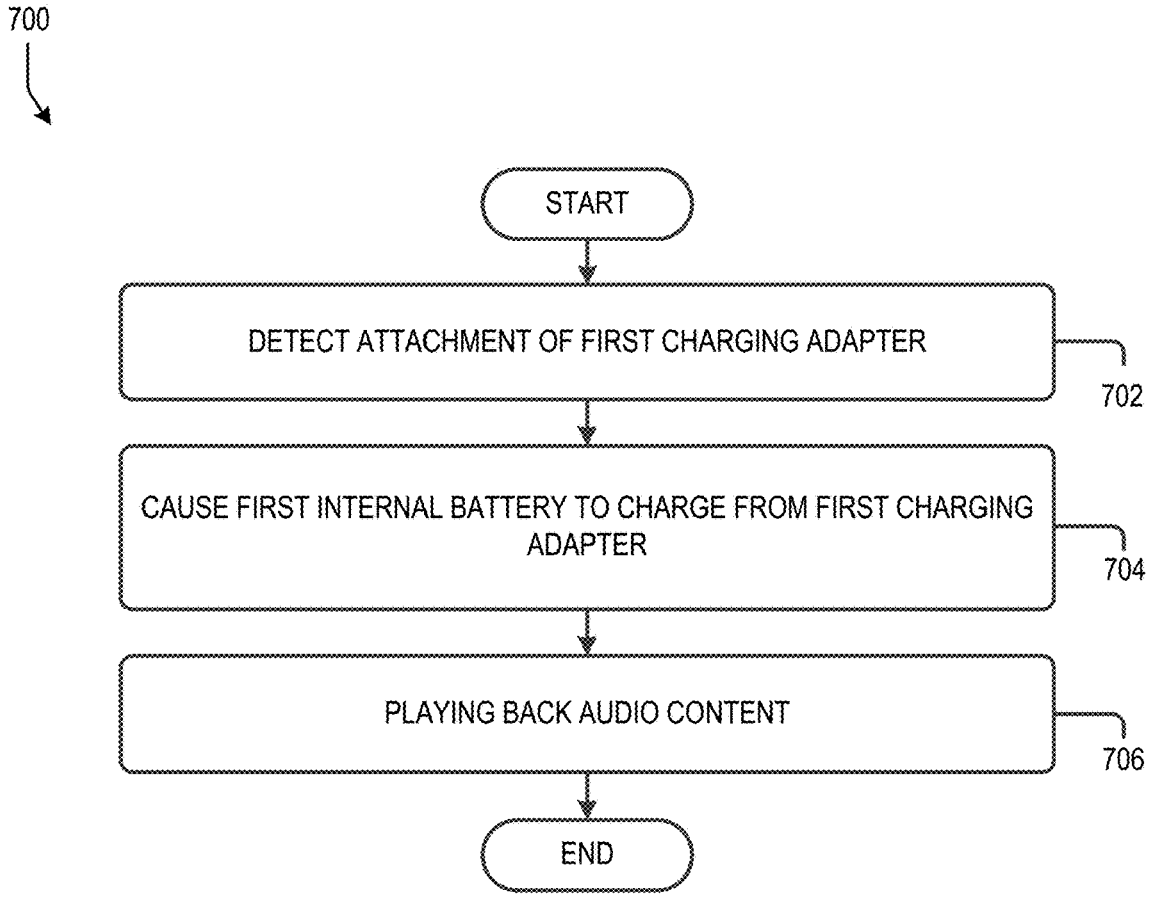

700
START
DETECT ATTACHMENT OF FIRST CHARGING ADAPTER
702
CAUSE FIRST INTERNAL BATTERY TO CHARGE FROM FIRST CHARGING ADAPTER
704
PLAYING BACK AUDIO CONTENT
706
END

Fig. 7

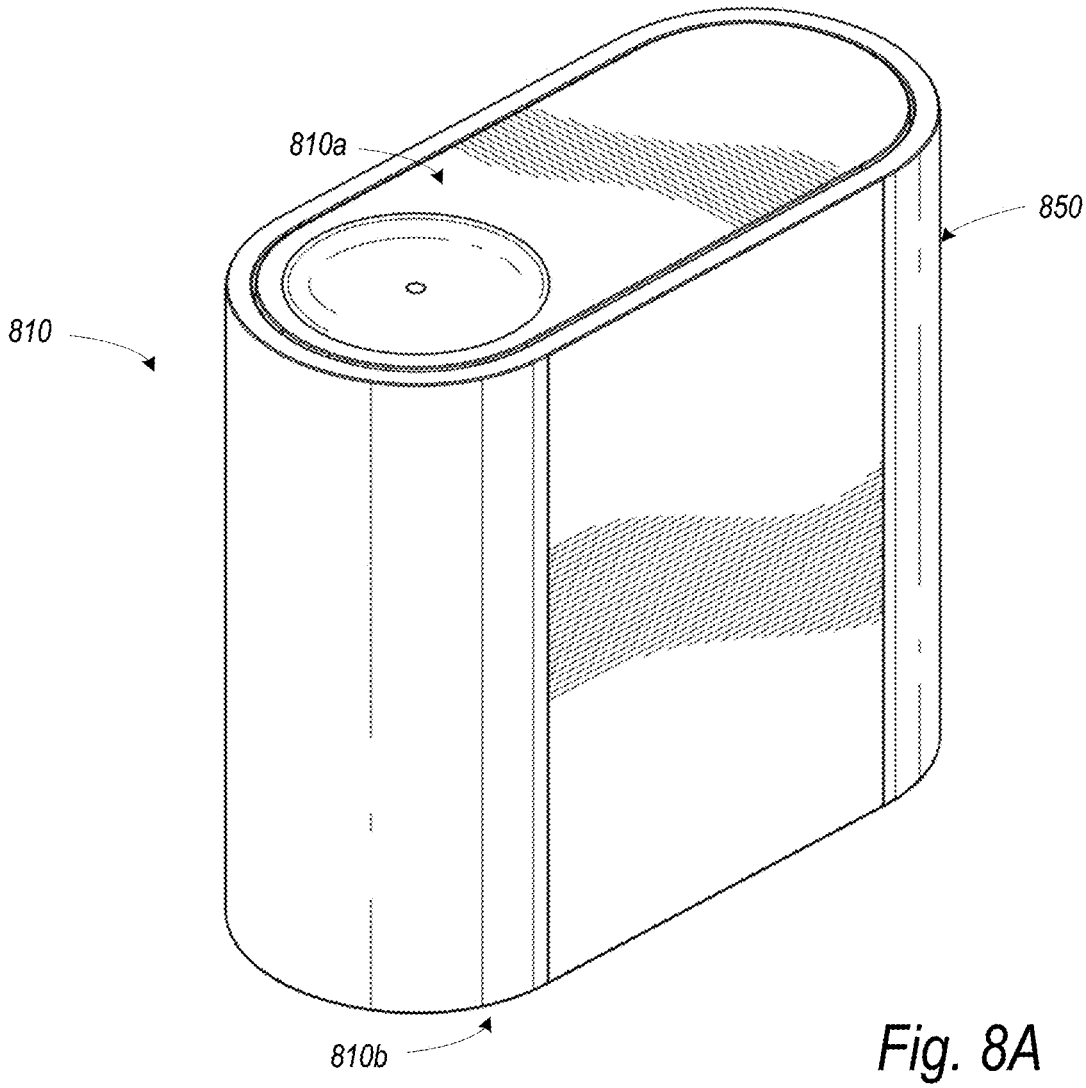


Fig. 8A

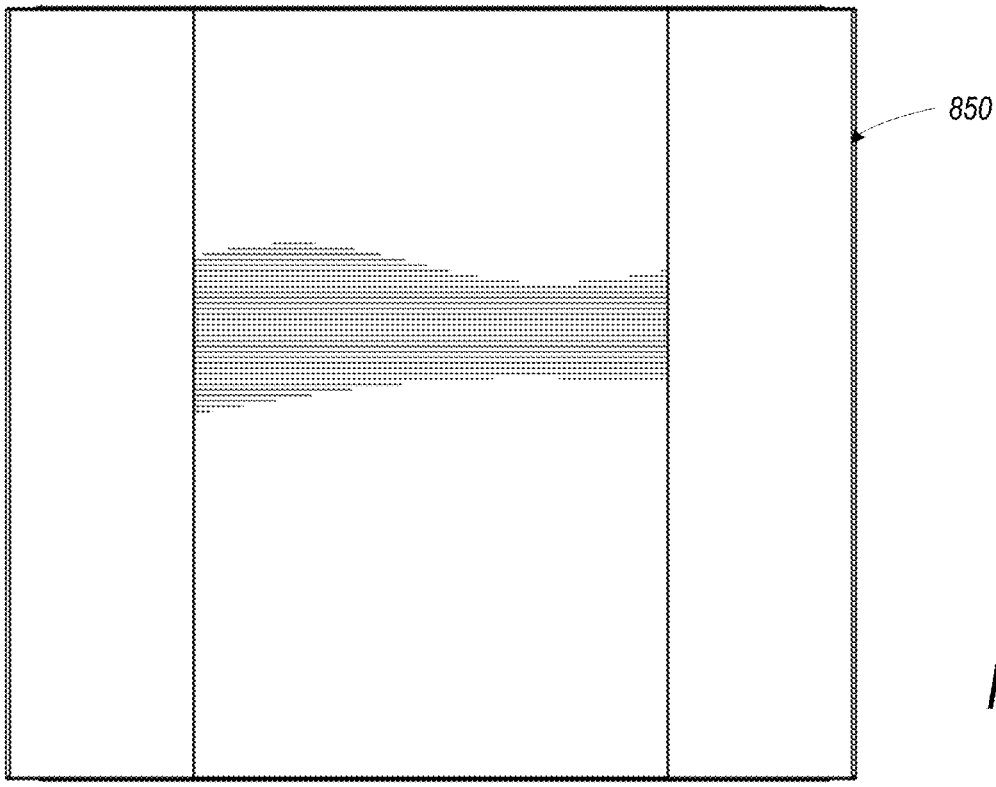


Fig. 8B

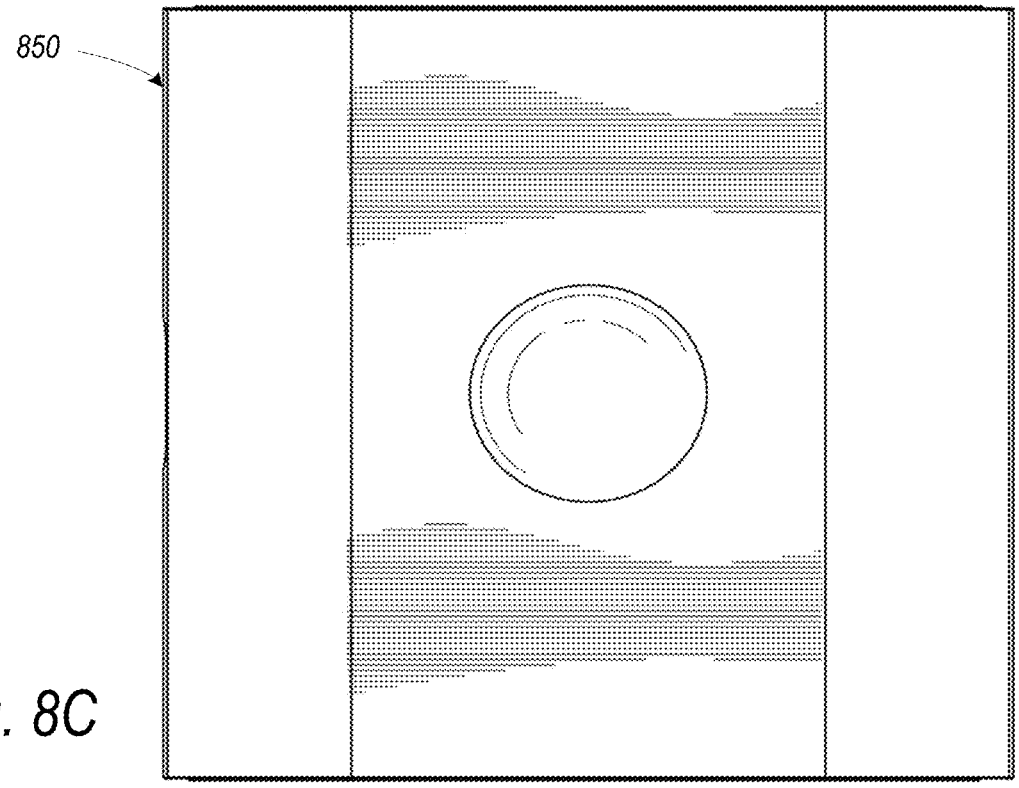


Fig. 8C

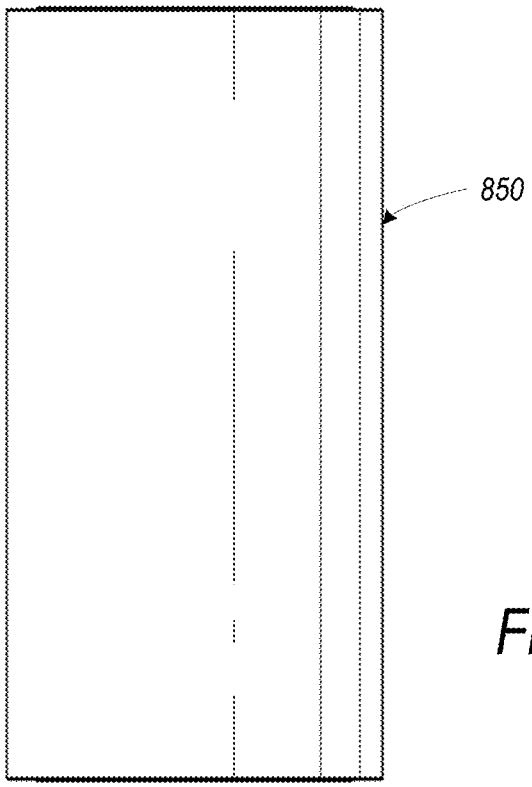


Fig. 8D

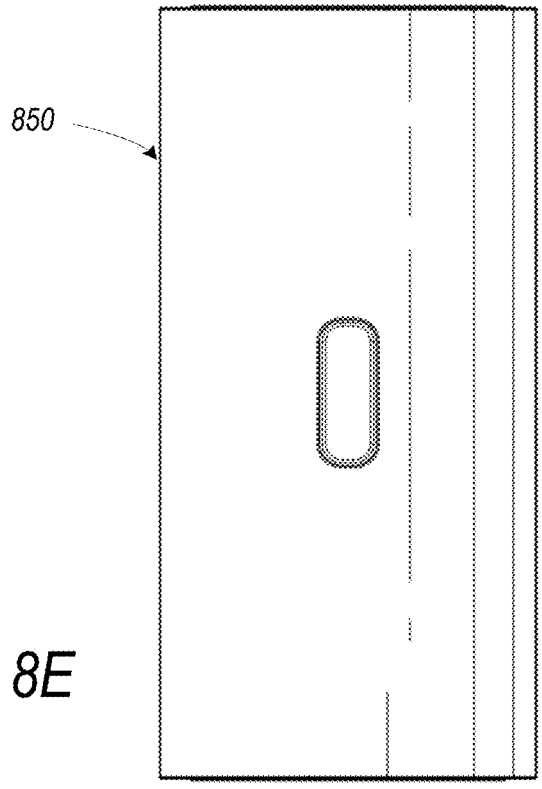
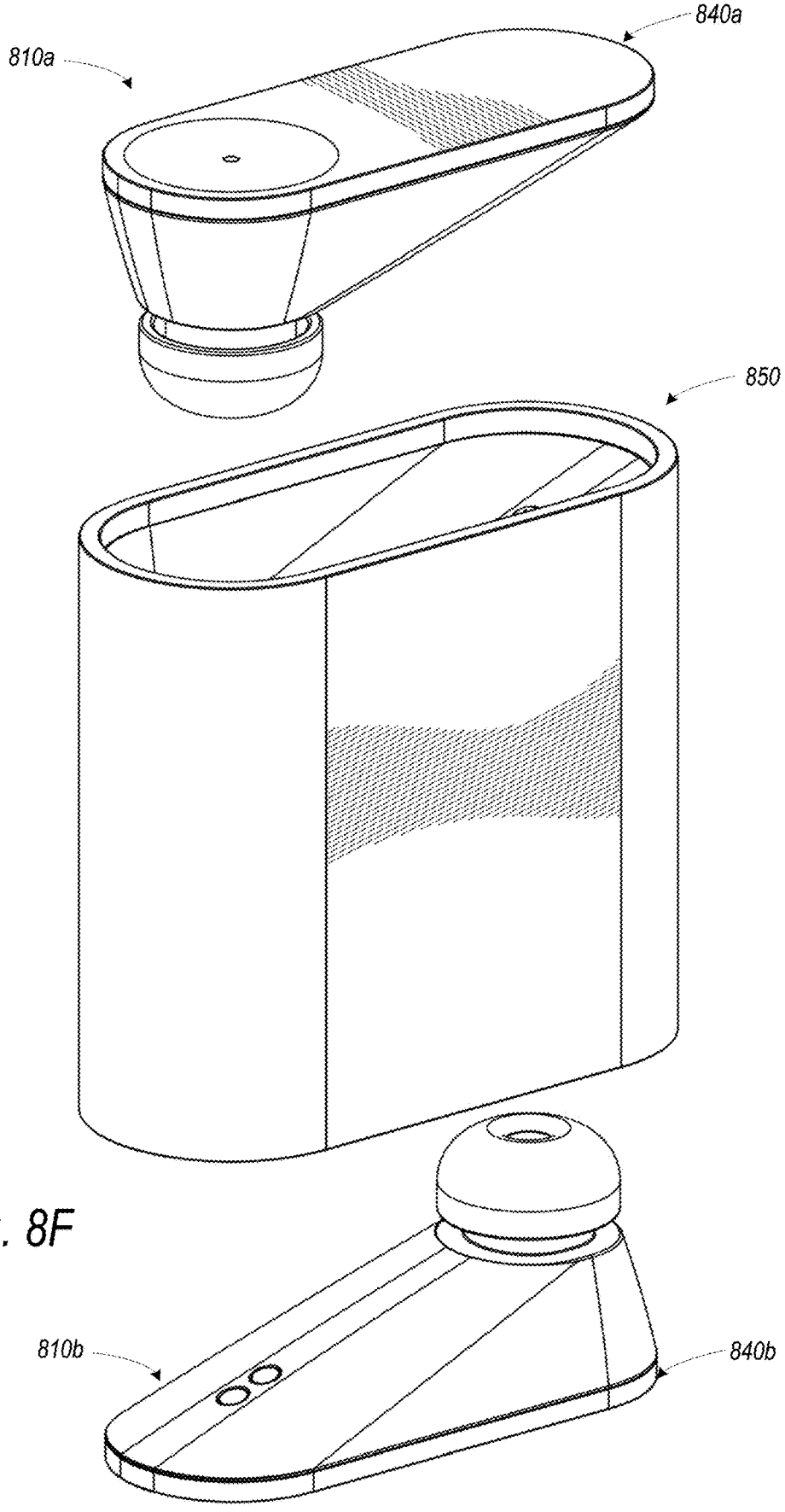


Fig. 8E



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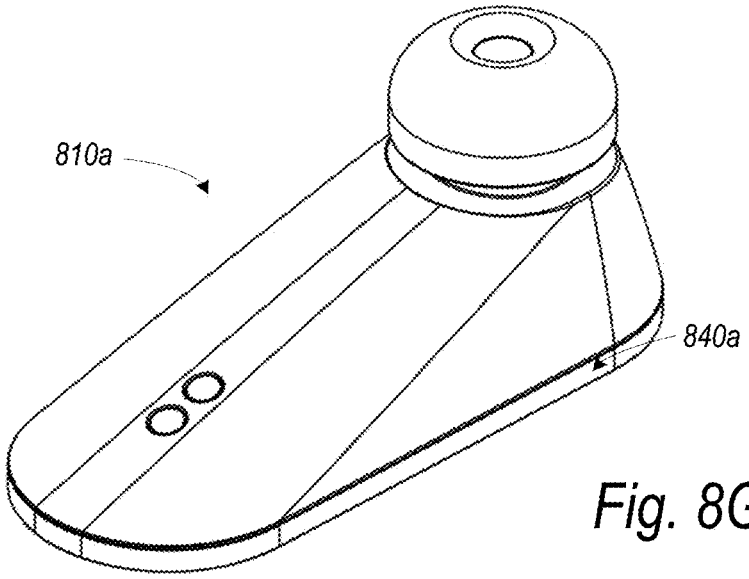


Fig. 8G

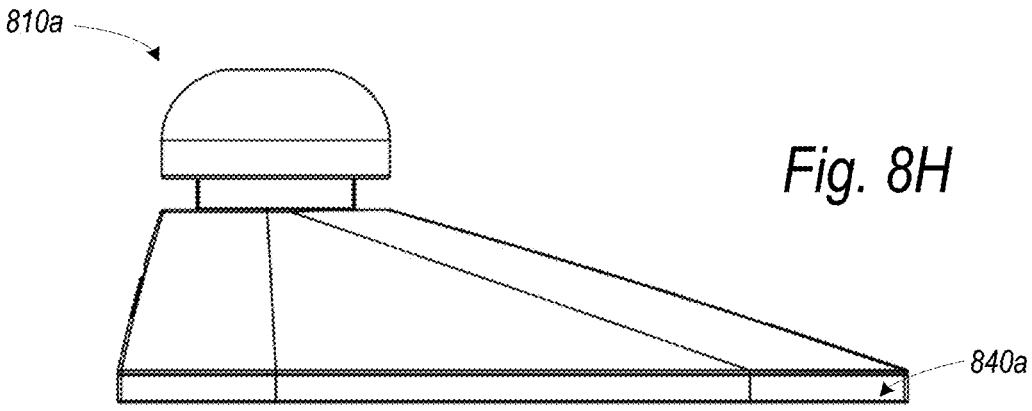
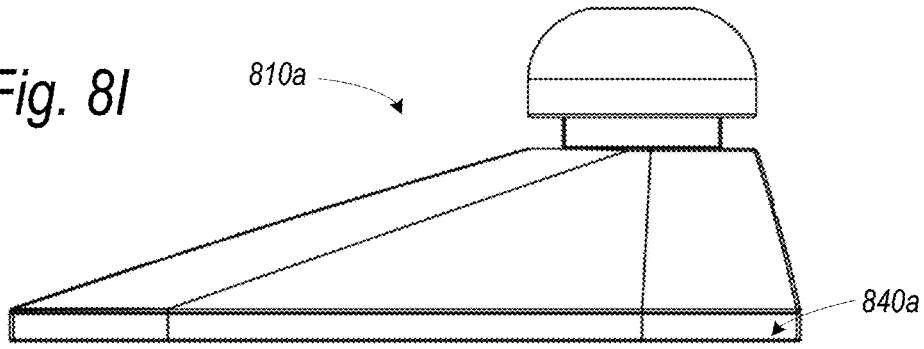


Fig. 8H

Fig. 8I



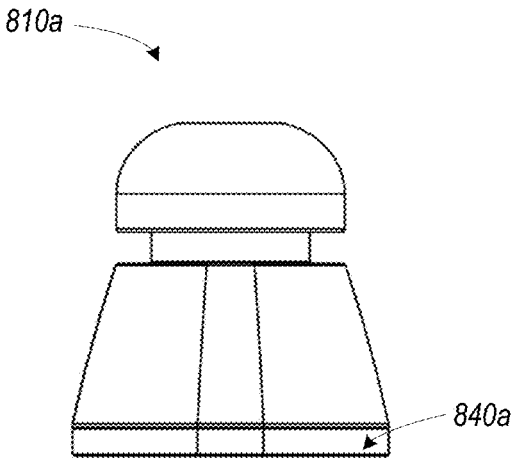
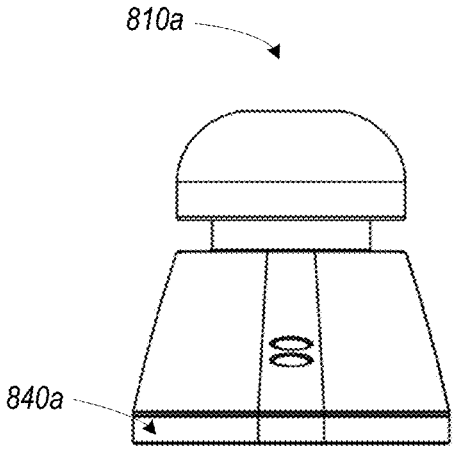


Fig. 8J



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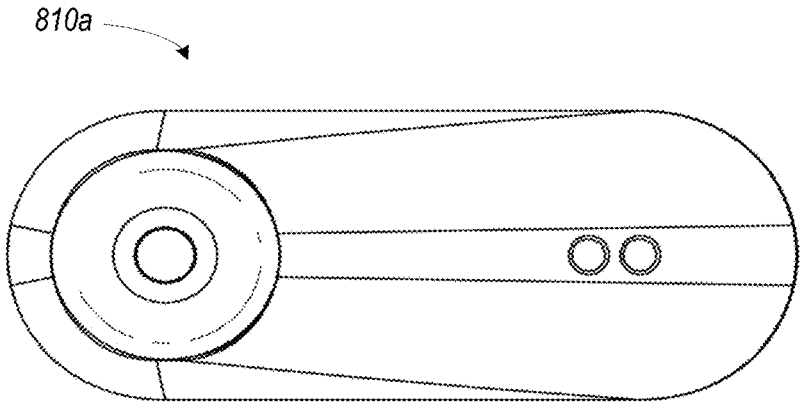

Fig. 8L

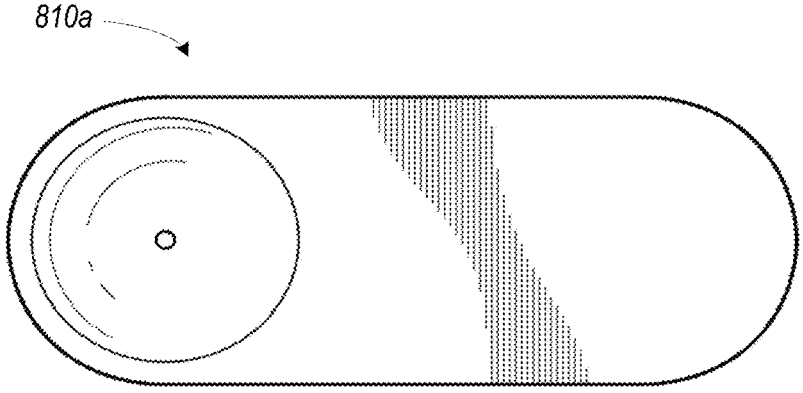

Fig. 8M

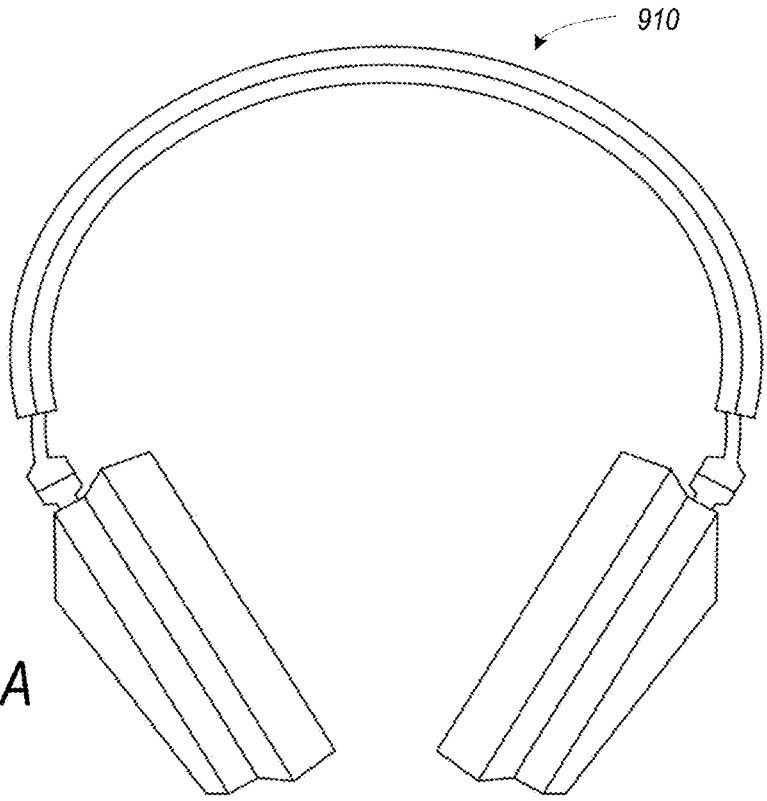

Fig. 9A

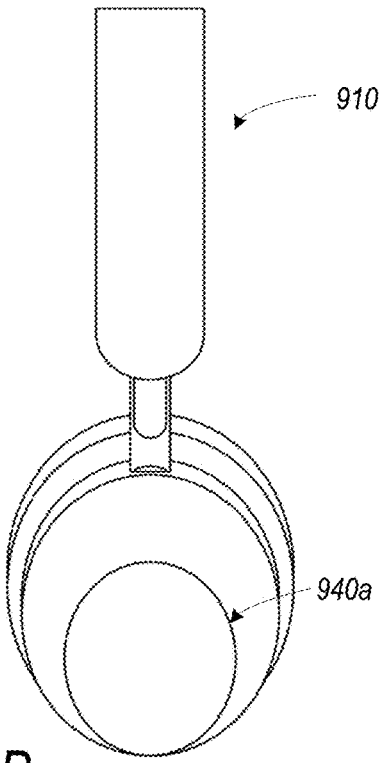

Fig. 9B

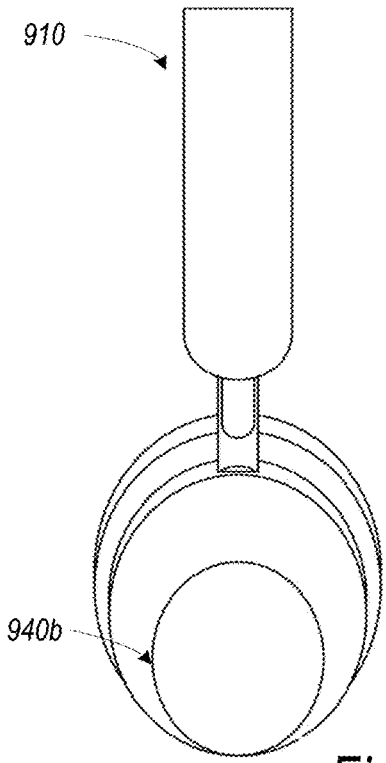

Fig. 9C

WIRELESS EARBUD CHARGING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. § 119 of U.S. provisional Patent Application No. 62/867,938, filed on Jun. 28, 2019, entitled "Wireless Earbud Charging," which is incorporated herein by reference in its entirety.

FIELD OF THE DISCLOSURE

[0002] The present disclosure is related to consumer goods and, more particularly, to methods, systems, products, features, services, and other elements directed to media playback or some aspect thereof.

BACKGROUND

[0003] Options for accessing and listening to digital audio in an out-loud setting were limited until in 2002, when SONOS, Inc. began development of a new type of playback system. Sonos then filed one of its first patent applications in 2003, entitled "Method for Synchronizing Audio Playback between Multiple Networked Devices," and began offering its first media playback systems for sale in 2005. The Sonos Wireless Home Sound System enables people to experience music from many sources via one or more networked playback devices. Through a software control application installed on a controller (e.g., smartphone, tablet, computer, voice input device), one can play what she wants in any room having a networked playback device. Media content (e.g., songs, podcasts, video sound) can be streamed to playback devices such that each room with a playback device can play back corresponding different media content. In addition, rooms can be grouped together for synchronous playback of the same media content, and/or the same media content can be heard in all rooms synchronously.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Features, aspects, and advantages of the presently disclosed technology may be better understood with regard to the following description, appended claims, and accompanying drawings, as listed below. A person skilled in the relevant art will understand that the features shown in the drawings are for purposes of illustrations, and variations, including different and/or additional features and arrangements thereof, are possible.

[0005] FIG. **1**A is a partial cutaway view of an environment having a media playback system configured in accordance with aspects of the disclosed technology.

[0006] FIG. **1**B is a schematic diagram of the media playback system of FIG. **1**A and one or more networks.

[0007] FIG. **1**C is a block diagram of a playback device.

[0008] FIG. **1**D is a block diagram of a playback device.

[0009] FIG. **1**E is a block diagram of a network microphone device.

[0010] FIG. **1**F is a block diagram of a network microphone device.

[0011] FIG. **1**G is a block diagram of a playback device.

[0012] FIG. **1**H is a partially schematic diagram of a control device.

[0013] FIG. **2**A is a block diagram of an earbud configured in accordance with aspects of the disclosed technology.

[0014] FIG. **2**B is a side partial cutaway view of the earbud configured in accordance with aspects of the disclosed technology.

[0015] FIG. **3**A is a side partial cutaway view of a charging adapter configured in accordance with aspects of the disclosed technology.

[0016] FIG. **3**B is a side partial cutaway view of the earbud and the charging adapter configured in accordance with aspects of the disclosed technology.

[0017] FIG. **3**C is another side partial cutaway view of the earbud and the charging adapter configured in accordance with aspects of the disclosed technology.

[0018] FIG. **4** is a side partial cutaway view of a charging case configured in accordance with aspects of the disclosed technology.

[0019] FIG. **5**A is a side partial cutaway view of a pair of earbuds, charging adapters, and a charging case configured in accordance with aspects of the disclosed technology.

[0020] FIG. **5**B is another side partial cutaway view of a pair of earbuds, charging adapters, and a charging case configured in accordance with aspects of the disclosed technology.

[0021] FIG. **5**C is another side partial cutaway view of a pair of earbuds, charging adapters, and a charging case configured in accordance with aspects of the disclosed technology.

[0022] FIG. **5**D is another side partial cutaway view of a pair of earbuds, charging adapters, and a charging case configured in accordance with aspects of the disclosed technology.

[0023] FIG. **6**A is a side partial cutaway view of a pair of earbuds, charging adapters, and a charging case configured in accordance with aspects of the disclosed technology.

[0024] FIG. **6**B is a side partial cutaway view of a pair of earbuds, charging adapters, and a charging case configured in accordance with aspects of the disclosed technology.

[0025] FIG. **7** is a flow diagram illustrating an example method to facilitate charging of one or more wireless earbuds in accordance with aspects of the disclosed technology.

[0026] FIG. **8**A is a front isometric view of earbuds configured in accordance with aspects of the disclosed technology.

[0027] FIG. **8**B is a bottom view of a charging case configured in accordance with aspects of the disclosed technology.

[0028] FIG. **8**C is a top view of the charging case.

[0029] FIG. **8**D is a first side view of the charging case.

[0030] FIG. **8**E is a second side view of the charging case.

[0031] FIG. **8**F is a front isometric view of earbuds illustrating exemplary arrangement with the charging case.

[0032] FIG. **8**G is an isometric view of the earbud.

[0033] FIG. **8**H is a first side view of the earbud.

[0034] FIG. **8**I is a second side view of the earbud.

[0035] FIG. **8**J is a third side view of the earbud.

[0036] FIG. **8**K is a fourth side view of the earbud.

[0037] FIG. **8**L is a fifth side view of the earbud.

[0038] FIG. **8**M is a sixth side view of the earbud.

[0039] FIG. **9**A is a front view of headphones configured in accordance with aspects of the disclosed technology.

[0040] FIG. **9**B is a first side view of the headphones.

[0041] FIG. **9**C is a second side view of the headphones.

[0042] The drawings are for the purpose of illustrating example embodiments, but those of ordinary skill in the art

will understand that the technology disclosed herein is not limited to the arrangements and/or instrumentality shown in the drawings.

DETAILED DESCRIPTION

I. Overview

[0043] Examples described herein relate to a charging system for wireless earbuds involving charging adapters that are attachable to the wireless earbuds. Wireless earbuds generally have limited play time due to size and weight requirements for comfortable use in-ear. Some wireless earbuds include one or more case batteries in a charging case, so that when the internal batteries of the wireless earbuds are depleted, they can be put into the charging case and recharged using the case batteries. While such a charging case allows wireless earbuds to be recharged away from wall power, one problem with this implementation is that the wireless earbuds cannot be used while they are being recharged in the charging case.

[0044] Other workarounds for limited play time of wireless earbuds exist as well. For instance, some users will charge one earbud while listening with the other one; the disadvantages of this approach include loss of stereo sound, as well as the additional attention required for switching between the earbuds. Some wireless earbuds support quick charging, such that 15 minutes of charging provides 1-2 hours of playtime; this approach, like the charging case, is disruptive to playback. Yet further, other wireless earbuds include a detectable neckband with an extra battery. This implementation is cumbersome and affects usability.

[0045] As noted above, example implementations described herein involve a charging adapter that includes one or more batteries (referred to herein as "adapter batteries"). In some implementations, the charging adapter is attachable to an external surface of an earbud using a magnetic or mechanical interface that align electrodes of the charging adapter with electrodes on the wireless headset, allowing an internal battery of the earbud to draw current and charge from the charging adapter while the earbud is in-ear. Then, when the internal battery is and recharged using a charging case or wall charger, the charging adapter can be detached from the earbud.

[0046] Given such charging adapters, example systems may include a charging case configured to charge the charging adapters independently of or concurrently with the earbuds. For instance, a charging case may include first and second volumes shaped to carry a first earbud and a second earbud while attached to a first charging adapter and a second charging adapter, respectively. Further, the charging case may be configured to carry the earbuds and charging adapters in such a manner that electrodes in the charging case, the charging adapters, and the earbuds align so that the charging case charges the charging adapters, which in turn charge the earbuds. Alternatively, the charging case may include separate volumes configured to carry a left earbud, a right earbud, and a first and second charging adapter.

[0047] In such implementations, the earbuds can be considered as operating in one of three different modes. In a first ("normal") mode, the earbuds are in-ear for playback, while the charging adapters are in the charging case being charged. In a second ("active charging") mode, the charging adapters are attached to the earbuds and charging the earbuds while the earbuds are in operation. In a third ("passive charging") mode, the charging adapters are attached to the earbuds and carried in the charging case. While in the passive charging mode, the charging case charges both the charging adapters and the earbuds, either independently or via attachment. If the charging case is disconnected from wall power, case batteries in the charging case charge the carried charging adapters and/or earbuds, until depleted. If the charging case is connected to wall power, the charging case charges its case batteries in addition to the charging adapters and the earbuds.

[0048] As noted above, example techniques described herein involve a system for wireless earbud charging. An example system includes a pair of earbuds including a first earbud and a second earbud, a first and second charging adapter comprising one or more respective charging batteries, and a charging case.

[0049] The first earbud includes a first IEEE 802.15-compatible interface, a first internal battery, a first audio driver, a housing carrying the first IEEE 802.15-compatible interface and the first internal battery. The housing of the first earbud comprises a first portion insertable into a first ear canal, the first portion carrying the first audio driver and a second portion carrying a magnetic interface that includes one or more magnets that (i) attach the first charging adapter externally to the housing of the first earbud and (ii) align electrodes of the first charging adapter to electrodes of the magnetic interface. The first earbud further includes a first controller carried in the housing of the first earbud and configured to perform functions comprising detecting attachment of the first charging adapter to the magnetic interface and based on detecting that the first charging adapter is attached to the magnetic interface, causing the first internal battery to charge from the first charging adapter. Charging the first internal battery comprises drawing current from the one or more adapter batteries of the first charging adapter via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter. The second earbud is similar to the first earbud.

[0050] While some examples described herein may refer to functions performed by given actors such as "users," "listeners," and/or other entities, it should be understood that this is for purposes of explanation only. The claims should not be interpreted to require action by any such example actor unless explicitly required by the language of the claims themselves.

[0051] Moreover, some functions are described herein as being performed "based on" or "in response to" another element or function. "Based on" should be understood that one element or function is related to another function or element. "In response to" should be understood that one element or function is a necessary result of another function or element. For the sake of brevity, functions are generally described as being based on another function when a functional link exists; however, such disclosure should be understood as disclosing either type of functional relationship.

[0052] In the Figures, identical reference numbers identify generally similar, and/or identical, elements. To facilitate the discussion of any particular element, the most significant digit or digits of a reference number refers to the Figure in which that element is first introduced. For example, element **110***a* is first introduced and discussed with reference to FIG. **1**A. Many of the details, dimensions, angles and other features shown in the Figures are merely illustrative of particular embodiments of the disclosed technology.

Accordingly, other embodiments can have other details, dimensions, angles and features without departing from the spirit or scope of the disclosure. In addition, those of ordinary skill in the art will appreciate that further embodiments of the various disclosed technologies can be practiced without several of the details described below.

II. Suitable Operating Environment

[0053] FIG. **1**A is a partial cutaway view of a media playback system **100** distributed in an environment **101** (e.g., a house). The media playback system **100** includes one or more playback devices **110** (identified individually as playback devices **110***a-n*), one or more network microphone devices ("NMDs"), **120** (identified individually as NMDs **120***a-c*), and one or more control devices **130** (identified individually as control devices **130***a* and **130***b*).

[0054] As used herein the term "playback device" can generally refer to a network device configured to receive, process, and output data of a media playback system. For example, a playback device can be a network device that receives and processes audio content. In some embodiments, a playback device includes one or more transducers or speakers powered by one or more amplifiers. In other embodiments, however, a playback device includes one of (or neither of) the speaker and the amplifier. For instance, a playback device can comprise one or more amplifiers configured to drive one or more speakers external to the playback device via a corresponding wire or cable.

[0055] Moreover, as used herein the term NMD (i.e., a "network microphone device") can generally refer to a network device that is configured for audio detection. In some embodiments, an NMD is a stand-alone device configured primarily for audio detection. In other embodiments, an NMD is incorporated into a playback device (or vice versa).

[0056] The term "control device" can generally refer to a network device configured to perform functions relevant to facilitating user access, control, and/or configuration of the media playback system **100**.

[0057] Each of the playback devices **110** is configured to receive audio signals or data from one or more media sources (e.g., one or more remote servers, one or more local devices) and play back the received audio signals or data as sound. The one or more NMDs **120** are configured to receive spoken word commands, and the one or more control devices **130** are configured to receive user input. In response to the received spoken word commands and/or user input, the media playback system **100** can play back audio via one or more of the playback devices **110**. In certain embodiments, the playback devices **110** are configured to commence playback of media content in response to a trigger. For instance, one or more of the playback devices **110** can be configured to play back a morning playlist upon detection of an associated trigger condition (e.g., presence of a user in a kitchen, detection of a coffee machine operation). In some embodiments, for example, the media playback system **100** is configured to play back audio from a first playback device (e.g., the playback device **100***a*) in synchrony with a second playback device (e.g., the playback device **100***b*). Interactions between the playback devices **110**, NMDs **120**, and/or control devices **130** of the media playback system **100** configured in accordance with the various embodiments of the disclosure are described in greater detail below with respect to FIGS. **1**B-**6**.

[0058] In the illustrated embodiment of FIG. **1**A, the environment **101** includes a household having several rooms, spaces, and/or playback zones, including (clockwise from upper left) a master bathroom **101***a*, a master bedroom **101***b*, a second bedroom **101***c*, a family room or den **101***d*, an office **101***e*, a living room **101***f*, a dining room **101***g*, a kitchen **101***h*, and an outdoor patio **101***i*. While certain embodiments and examples are described below in the context of a home environment, the technologies described herein may be implemented in other types of environments. In some embodiments, for example, the media playback system **100** can be implemented in one or more commercial settings (e.g., a restaurant, mall, airport, hotel, a retail or other store), one or more vehicles (e.g., a sports utility vehicle, bus, car, a ship, a boat, an airplane), multiple environments (e.g., a combination of home and vehicle environments), and/or another suitable environment where multi-zone audio may be desirable.

[0059] The media playback system **100** can comprise one or more playback zones, some of which may correspond to the rooms in the environment **101**. The media playback system **100** can be established with one or more playback zones, after which additional zones may be added, or removed to form, for example, the configuration shown in FIG. **1**A. Each zone may be given a name according to a different room or space such as the office **101***e*, master bathroom **101***a*, master bedroom **101***b*, the second bedroom **101***c*, kitchen **101***h*, dining room **101***g*, living room **101***f*, and/or the balcony **101***i*. In some aspects, a single playback zone may include multiple rooms or spaces. In certain aspects, a single room or space may include multiple playback zones.

[0060] In the illustrated embodiment of FIG. **1**A, the master bathroom **101***a*, the second bedroom **101***c*, the office **101***e*, the living room **101***f*, the dining room **101***g*, the kitchen **101***h*, and the outdoor patio **101***i* each include one playback device **110**, and the master bedroom **101***b* and the den **101***d* include a plurality of playback devices **110**. In the master bedroom **101***b*, the playback devices **110***l* and **110***m* may be configured, for example, to play back audio content in synchrony as individual ones of playback devices **110**, as a bonded playback zone, as a consolidated playback device, and/or any combination thereof. Similarly, in the den **101***d*, the playback devices **110***h -j* can be configured, for instance, to play back audio content in synchrony as individual ones of playback devices **110**, as one or more bonded playback devices, and/or as one or more consolidated playback devices. Additional details regarding bonded and consolidated playback devices are described below with respect to FIGS. **1**B and **1**E.

[0061] In some aspects, one or more of the playback zones in the environment **101** may each be playing different audio content. For instance, a user may be grilling on the patio **101***i* and listening to hip hop music being played by the playback device **110***c* while another user is preparing food in the kitchen **101***h* and listening to classical music played by the playback device **110***b*. In another example, a playback zone may play the same audio content in synchrony with another playback zone. For instance, the user may be in the office **101***e* listening to the playback device **110***f* playing back the same hip hop music being played back by playback device **110***c* on the patio **101***i*. In some aspects, the playback devices **110***c* and **110***f* play back the hip hop music in synchrony such that the user perceives that the audio content

is being played seamlessly (or at least substantially seamlessly) while moving between different playback zones.

[0062] Example synchrony techniques involve a group coordinator providing audio content and timing information to one or more group members to facilitate synchronous playback among the group coordinator and the group members. Additional details regarding audio playback synchronization among playback devices and/or zones can be found, for example, in U.S. Pat. No. 8,234,395 entitled, "System and method for synchronizing operations among a plurality of independently clocked digital data processing devices," which is incorporated herein by reference in its entirety.

a. Suitable Media Playback System

[0063] FIG. **1**B is a schematic diagram of the media playback system **100** and a cloud network **102**. For ease of illustration, certain devices of the media playback system **100** and the cloud network **102** are omitted from FIG. **1**B. One or more communication links **103** (referred to hereinafter as "the links **103**") communicatively couple the media playback system **100** and the cloud network **102**.

[0064] The links **103** can comprise, for example, one or more wired networks, one or more wireless networks, one or more wide area networks (WAN), one or more local area networks (LAN), one or more personal area networks (PAN), one or more telecommunication networks (e.g., one or more Global System for Mobiles (GSM) networks, Code Division Multiple Access (CDMA) networks, Long-Term Evolution (LTE) networks, 5G communication network networks, and/or other suitable data transmission protocol networks), etc. The cloud network **102** is configured to deliver media content (e.g., audio content, video content, photographs, social media content) to the media playback system **100** in response to a request transmitted from the media playback system **100** via the links **103**. In some embodiments, the cloud network **102** is further configured to receive data (e.g. voice input data) from the media playback system **100** and correspondingly transmit commands and/or media content to the media playback system **100**.

[0065] The cloud network **102** includes computing devices **106** (identified separately as a first computing device **106***a*, a second computing device **106***b*, and a third computing device **106***c*). The computing devices **106** can comprise individual computers or servers, such as, for example, a media streaming service server storing audio and/or other media content, a voice service server, a social media server, a media playback system control server, etc. In some embodiments, one or more of the computing devices **106** comprise modules of a single computer or server. In certain embodiments, one or more of the computing devices **106** comprise one or more modules, computers, and/or servers. Moreover, while the cloud network **102** is described above in the context of a single cloud network, in some embodiments the cloud network **102** includes a plurality of cloud networks comprising communicatively coupled computing devices. Furthermore, while the cloud network **102** is shown in FIG. **1**B as having three of the computing devices **106**, in some embodiments, the cloud network **102** includes fewer (or more than) three computing devices **106**.

[0066] The media playback system **100** is configured to receive media content from the networks **102** via the links **103**. The received media content can comprise, for example, a Uniform Resource Identifier (URI) and/or a Uniform Resource Locator (URL). For instance, in some examples, the media playback system **100** can stream, download, or otherwise obtain data from a URI or a URL corresponding to the received media content. A network **104** communicatively couples the links **103** and at least a portion of the devices (e.g., one or more of the playback devices **110**, NMDs **120**, and/or control devices **130**) of the media playback system **100**. The network **104** can include, for example, a wireless network (e.g., a WiFi network, a Bluetooth, a Z-Wave network, a ZigBee, and/or other suitable wireless communication protocol network) and/or a wired network (e.g., a network comprising Ethernet, Universal Serial Bus (USB), and/or another suitable wired communication). As those of ordinary skill in the art will appreciate, as used herein, "WiFi" can refer to several different communication protocols including, for example, Institute of Electrical and Electronics Engineers (IEEE) 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac, 802.11ac, 802.11ad, 802.11af, 802.11ah, 802.11ai, 802.11aj, 802.11aq, 802.11ax, 802.11ay, 802.15, etc. transmitted at 2.4 Gigahertz (GHz), 5 GHz, and/or another suitable frequency.

[0067] In some embodiments, the network **104** includes a dedicated communication network that the media playback system **100** uses to transmit messages between individual devices and/or to transmit media content to and from media content sources (e.g., one or more of the computing devices **106**). In certain embodiments, the network **104** is configured to be accessible only to devices in the media playback system **100**, thereby reducing interference and competition with other household devices. In other embodiments, however, the network **104** includes an existing household communication network (e.g., a household WiFi network). In some embodiments, the links **103** and the network **104** comprise one or more of the same networks. In some aspects, for example, the links **103** and the network **104** comprise a telecommunication network (e.g., an LTE network, a 5G network). Moreover, in some embodiments, the media playback system **100** is implemented without the network **104**, and devices comprising the media playback system **100** can communicate with each other, for example, via one or more direct connections, PANs, telecommunication networks, and/or other suitable communication links.

[0068] In some embodiments, audio content sources may be regularly added or removed from the media playback system **100**. In some embodiments, for example, the media playback system **100** performs an indexing of media items when one or more media content sources are updated, added to, and/or removed from the media playback system **100**. The media playback system **100** can scan identifiable media items in some or all folders and/or directories accessible to the playback devices **110**, and generate or update a media content database comprising metadata (e.g., title, artist, album, track length) and other associated information (e.g., URIs, URLs) for each identifiable media item found. In some embodiments, for example, the media content database is stored on one or more of the playback devices **110**, network microphone devices **120**, and/or control devices **130**.

[0069] In the illustrated embodiment of FIG. **1**B, the playback devices **110***l* and **110***m* comprise a group **107***a*. The playback devices **110***l* and **110***m* can be positioned in different rooms in a household and be grouped together in the group **107***a* on a temporary or permanent basis based on user input received at the control device **130***a* and/or another control device **130** in the media playback system **100**. When

arranged in the group **107***a*, the playback devices **110***l* and **110***m* can be configured to play back the same or similar audio content in synchrony from one or more audio content sources. In certain embodiments, for example, the group **107***a* includes a bonded zone in which the playback devices **110***l* and **110***m* comprise left audio and right audio channels, respectively, of multi-channel audio content, thereby producing or enhancing a stereo effect of the audio content. In some embodiments, the group **107***a* includes additional playback devices **110**. In other embodiments, however, the media playback system **100** omits the group **107***a* and/or other grouped arrangements of the playback devices **110**.

[0070] The media playback system **100** includes the NMDs **120***a* and **120***d*, each comprising one or more microphones configured to receive voice utterances from a user. In the illustrated embodiment of FIG. **1**B, the NMD **120***a* is a standalone device and the NMD **120***d* is integrated into the playback device **110***n*. The NMD **120***a*, for example, is configured to receive voice input **121** from a user **123**. In some embodiments, the NMD **120***a* transmits data associated with the received voice input **121** to a voice assistant service (VAS) configured to (i) process the received voice input data and (ii) transmit a corresponding command to the media playback system **100**. In some aspects, for example, the computing device **106***c* includes one or more modules and/or servers of a VAS (e.g., a VAS operated by one or more of SONOS®, AMAZON®, GOOGLE® APPLE®, MICROSOFT®). The computing device **106***c* can receive the voice input data from the NMD **120***a* via the network **104** and the links **103**. In response to receiving the voice input data, the computing device **106***c* processes the voice input data (i.e., "Play Hey Jude by The Beatles"), and determines that the processed voice input includes a command to play a song (e.g., "Hey Jude"). The computing device **106***c* accordingly transmits commands to the media playback system **100** to play back "Hey Jude" by the Beatles from a suitable media service (e.g., via one or more of the computing devices **106**) on one or more of the playback devices **110**.

b. Suitable Playback Devices

[0071] FIG. **1**C is a block diagram of the playback device **110***a* comprising an input/output **111**. The input/output **111** can include an analog I/O **111***a* (e.g., one or more wires, cables, and/or other suitable communication links configured to carry analog signals) and/or a digital I/O **111***b* (e.g., one or more wires, cables, or other suitable communication links configured to carry digital signals). In some embodiments, the analog I/O **111***a* is an audio line-in input connection comprising, for example, an auto-detecting 3.5 mm audio line-in connection. In some embodiments, the digital I/O **111***b* includes a Sony/Philips Digital Interface Format (S/PDIF) communication interface and/or cable and/or a Toshiba Link (TOSLINK) cable. In some embodiments, the digital I/O **111***b* includes an High-Definition Multimedia Interface (HDMI) interface and/or cable. In some embodiments, the digital I/O **111***b* includes one or more wireless communication links comprising, for example, a radio frequency (RF), infrared, WiFi, Bluetooth, or another suitable communication protocol. In certain embodiments, the analog I/O **111***a* and the digital **111***b* comprise interfaces (e.g., ports, plugs, jacks) configured to receive connectors of cables transmitting analog and digital signals, respectively, without necessarily including cables.

[0072] The playback device **110***a*, for example, can receive media content (e.g., audio content comprising music and/or other sounds) from a local audio source **105** via the input/output **111** (e.g., a cable, a wire, a PAN, a Bluetooth connection, an ad hoc wired or wireless communication network, and/or another suitable communication link). The local audio source **105** can comprise, for example, a mobile device (e.g., a smartphone, a tablet, a laptop computer) or another suitable audio component (e.g., a television, a desktop computer, an amplifier, a phonograph, a Blu-ray player, a memory storing digital media files). In some aspects, the local audio source **105** includes local music libraries on a smartphone, a computer, a networked-attached storage (NAS), and/or another suitable device configured to store media files. In certain embodiments, one or more of the playback devices **110**, NMDs **120**, and/or control devices **130** comprise the local audio source **105**. In other embodiments, however, the media playback system omits the local audio source **105** altogether. In some embodiments, the playback device **110***a* does not include an input/output **111** and receives all audio content via the network **104**.

[0073] The playback device **110***a* further includes electronics **112**, a user interface **113** (e.g., one or more buttons, knobs, dials, touch-sensitive surfaces, displays, touchscreens), and one or more transducers **114** (referred to hereinafter as "the transducers **114**"). The electronics **112** is configured to receive audio from an audio source (e.g., the local audio source **105**) via the input/output **111**, one or more of the computing devices **106***a-c* via the network **104** (FIG. **1**B)), amplify the received audio, and output the amplified audio for playback via one or more of the transducers **114**. In some embodiments, the playback device **110***a* optionally includes one or more microphones **115** (e.g., a single microphone, a plurality of microphones, a microphone array) (hereinafter referred to as "the microphones **115**"). In certain embodiments, for example, the playback device **110***a* having one or more of the optional microphones **115** can operate as an NMD configured to receive voice input from a user and correspondingly perform one or more operations based on the received voice input.

[0074] In the illustrated embodiment of FIG. **1**C, the electronics **112** comprise one or more processors **112***a* (referred to hereinafter as "the processors **112***a*"), memory **112***b*, software components **112***c*, a network interface **112***d*, one or more audio processing components **112***g* (referred to hereinafter as "the audio components **112***g*"), one or more audio amplifiers **112***h* (referred to hereinafter as "the amplifiers **112***h*"), and power **112***i* (e.g., one or more power supplies, power cables, power receptacles, batteries, induction coils, Power-over Ethernet (POE) interfaces, and/or other suitable sources of electric power). In some embodiments, the electronics **112** optionally include one or more other components **112***j* (e.g., one or more sensors, video displays, touchscreens).

[0075] The processors **112***a* can comprise clock-driven computing component(s) configured to process data, and the memory **112***b* can comprise a computer-readable medium (e.g., a tangible, non-transitory computer-readable medium, data storage loaded with one or more of the software components **112***c*) configured to store instructions for performing various operations and/or functions. The processors **112***a* are configured to execute the instructions stored on the memory **112***b* to perform one or more of the operations. The operations can include, for example, causing the playback

device **110***a* to retrieve audio data from an audio source (e.g., one or more of the computing devices **106***a-c* (FIG. **1**B)), and/or another one of the playback devices **110**. In some embodiments, the operations further include causing the playback device **110***a* to send audio data to another one of the playback devices **110***a* and/or another device (e.g., one of the NMDs **120**). Certain embodiments include operations causing the playback device **110***a* to pair with another of the one or more playback devices **110** to enable a multi-channel audio environment (e.g., a stereo pair, a bonded zone).

[0076] The processors **112***a* can be further configured to perform operations causing the playback device **110***a* to synchronize playback of audio content with another of the one or more playback devices **110**. As those of ordinary skill in the art will appreciate, during synchronous playback of audio content on a plurality of playback devices, a listener will preferably be unable to perceive time-delay differences between playback of the audio content by the playback device **110***a* and the other one or more other playback devices **110**. Additional details regarding audio playback synchronization among playback devices can be found, for example, in U.S. Pat. No. 8,234,395, which was incorporated by reference above.

[0077] In some embodiments, the memory **112***b* is further configured to store data associated with the playback device **110***a*, such as one or more zones and/or zone groups of which the playback device **110***a* is a member, audio sources accessible to the playback device **110***a*, and/or a playback queue that the playback device **110***a* (and/or another of the one or more playback devices) can be associated with. The stored data can comprise one or more state variables that are periodically updated and used to describe a state of the playback device **110***a*. The memory **112***b* can also include data associated with a state of one or more of the other devices (e.g., the playback devices **110**, NMDs **120**, control devices **130**) of the media playback system **100**. In some aspects, for example, the state data is shared during predetermined intervals of time (e.g., every 5 seconds, every 10 seconds, every 60 seconds) among at least a portion of the devices of the media playback system **100**, so that one or more of the devices have the most recent data associated with the media playback system **100**.

[0078] The network interface **112***d* is configured to facilitate a transmission of data between the playback device **110***a* and one or more other devices on a data network such as, for example, the links **103** and/or the network **104** (FIG. **1**B). The network interface **112***d* is configured to transmit and receive data corresponding to media content (e.g., audio content, video content, text, photographs) and other signals (e.g., non-transitory signals) comprising digital packet data including an Internet Protocol (IP)-based source address and/or an IP-based destination address. The network interface **112***d* can parse the digital packet data such that the electronics **112** properly receives and processes the data destined for the playback device **110***a*.

[0079] In the illustrated embodiment of FIG. **1**C, the network interface **112***d* includes one or more wireless interfaces **112***e* (referred to hereinafter as "the wireless interface **112***e*"). The wireless interface **112***e* (e.g., a suitable interface comprising one or more antennae) can be configured to wirelessly communicate with one or more other devices (e.g., one or more of the other playback devices **110**, NMDs **120**, and/or control devices **130**) that are communicatively coupled to the network **104** (FIG. **1**B) in accordance with a suitable wireless communication protocol (e.g., WiFi, Bluetooth, LTE). In some embodiments, the network interface **112***d* optionally includes a wired interface **112***f* (e.g., an interface or receptacle configured to receive a network cable such as an Ethernet, a USB-A, USB-C, and/or Thunderbolt cable) configured to communicate over a wired connection with other devices in accordance with a suitable wired communication protocol. In certain embodiments, the network interface **112***d* includes the wired interface **112***f* and excludes the wireless interface **112***e*. In some embodiments, the electronics **112** excludes the network interface **112***d* altogether and transmits and receives media content and/or other data via another communication path (e.g., the input/output **111**).

[0080] The audio components **112***g* are configured to process and/or filter data comprising media content received by the electronics **112** (e.g., via the input/output **111** and/or the network interface **112***d*) to produce output audio signals. In some embodiments, the audio processing components **112***g* comprise, for example, one or more digital-to-analog converters (DAC), audio preprocessing components, audio enhancement components, a digital signal processors (DSPs), and/or other suitable audio processing components, modules, circuits, etc. In certain embodiments, one or more of the audio processing components **112***g* can comprise one or more subcomponents of the processors **112***a*. In some embodiments, the electronics **112** omits the audio processing components **112***g*. In some aspects, for example, the processors **112***a* execute instructions stored on the memory **112***b* to perform audio processing operations to produce the output audio signals.

[0081] The amplifiers **112***h* are configured to receive and amplify the audio output signals produced by the audio processing components **112***g* and/or the processors **112***a*. The amplifiers **112***h* can comprise electronic devices and/or components configured to amplify audio signals to levels sufficient for driving one or more of the transducers **114**. In some embodiments, for example, the amplifiers **112***h* include one or more switching or class-D power amplifiers. In other embodiments, however, the amplifiers include one or more other types of power amplifiers (e.g., linear gain power amplifiers, class-A amplifiers, class-B amplifiers, class-AB amplifiers, class-C amplifiers, class-D amplifiers, class-E amplifiers, class-F amplifiers, class-G and/or class H amplifiers, and/or another suitable type of power amplifier). In certain embodiments, the amplifiers **112***h* comprise a suitable combination of two or more of the foregoing types of power amplifiers. Moreover, in some embodiments, individual ones of the amplifiers **112***h* correspond to individual ones of the transducers **114**. In other embodiments, however, the electronics **112** includes a single one of the amplifiers **112***h* configured to output amplified audio signals to a plurality of the transducers **114**. In some other embodiments, the electronics **112** omits the amplifiers **112***h*.

[0082] The transducers **114** (e.g., one or more speakers and/or speaker drivers) receive the amplified audio signals from the amplifier **112***h* and render or output the amplified audio signals as sound (e.g., audible sound waves having a frequency between about 20 Hertz (Hz) and 20 kilohertz (kHz)). In some embodiments, the transducers **114** can comprise a single transducer. In other embodiments, however, the transducers **114** comprise a plurality of audio transducers. In some embodiments, the transducers **114**

comprise more than one type of transducer. For example, the transducers **114** can include one or more low frequency transducers (e.g., subwoofers, woofers), mid-range frequency transducers (e.g., mid-range transducers, mid-woofers), and one or more high frequency transducers (e.g., one or more tweeters). As used herein, "low frequency" can generally refer to audible frequencies below about 500 Hz, "mid-range frequency" can generally refer to audible frequencies between about 500 Hz and about 2 kHz, and "high frequency" can generally refer to audible frequencies above 2 kHz. In certain embodiments, however, one or more of the transducers **114** comprise transducers that do not adhere to the foregoing frequency ranges. For example, one of the transducers **114** may comprise a mid-woofer transducer configured to output sound at frequencies between about 200 Hz and about 5 kHz.

[0083] By way of illustration, SONOS, Inc. presently offers (or has offered) for sale certain playback devices including, for example, a "SONOS ONE," "PLAY:1," "PLAY:3," "PLAY:5," "PLAYBAR," "PLAYBASE," "CONNECT:AMP," "CONNECT," and "SUB." Other suitable playback devices may additionally or alternatively be used to implement the playback devices of example embodiments disclosed herein. Additionally, one of ordinary skilled in the art will appreciate that a playback device is not limited to the examples described herein or to SONOS product offerings. In some embodiments, for example, one or more playback devices **110** includes wired or wireless headphones (e.g., over-the-ear headphones, on-ear headphones, in-ear earphones). In other embodiments, one or more of the playback devices **110** comprise a docking station and/or an interface configured to interact with a docking station for personal mobile media playback devices. In certain embodiments, a playback device may be integral to another device or component such as a television, a lighting fixture, or some other device for indoor or outdoor use. In some embodiments, a playback device omits a user interface and/or one or more transducers. For example, FIG. **1**D is a block diagram of a playback device **110***p* comprising the input/output **111** and electronics **112** without the user interface **113** or transducers **114**.

[0084] FIG. **1**E is a block diagram of a bonded playback device **110***q* comprising the playback device **110***a* (FIG. **1**C) sonically bonded with the playback device **110***i* (e.g., a subwoofer) (FIG. **1**A). In the illustrated embodiment, the playback devices **110***a* and **110***i* are separate ones of the playback devices **110** housed in separate enclosures. In some embodiments, however, the bonded playback device **110***q* includes a single enclosure housing both the playback devices **110***a* and **110***i*. The bonded playback device **110***q* can be configured to process and reproduce sound differently than an unbonded playback device (e.g., the playback device **110***a* of FIG. **1**C) and/or paired or bonded playback devices (e.g., the playback devices **110***l* and **110***m* of FIG. **1**B). In some embodiments, for example, the playback device **110***a* is full-range playback device configured to render low frequency, mid-range frequency, and high frequency audio content, and the playback device **110***i* is a subwoofer configured to render low frequency audio content. In some aspects, the playback device **110***a*, when bonded with the first playback device, is configured to render only the mid-range and high frequency components of a particular audio content, while the playback device **110***i* renders the low frequency component of the particular audio content. In some embodiments, the bonded playback device **110***q* includes additional playback devices and/or another bonded playback device.

c. Suitable Network Microphone Devices (NMDs)

[0085] FIG. **1**F is a block diagram of the NMD **120***a* (FIGS. **1**A and **1**B). The NMD **120***a* includes one or more voice processing components **124** (hereinafter "the voice components **124**") and several components described with respect to the playback device **110***a* (FIG. **1**C) including the processors **112***a*, the memory **112***b*, and the microphones **115**. The NMD **120***a* optionally includes other components also included in the playback device **110***a* (FIG. **1**C), such as the user interface **113** and/or the transducers **114**. In some embodiments, the NMD **120***a* is configured as a media playback device (e.g., one or more of the playback devices **110**), and further includes, for example, one or more of the audio components **112***g* (FIG. **1**C), the amplifiers **114**, and/or other playback device components. In certain embodiments, the NMD **120***a* includes an Internet of Things (IoT) device such as, for example, a thermostat, alarm panel, fire and/or smoke detector, etc. In some embodiments, the NMD **120***a* includes the microphones **115**, the voice processing **124**, and only a portion of the components of the electronics **112** described above with respect to FIG. **1**B. In some aspects, for example, the NMD **120***a* includes the processor **112***a* and the memory **112***b* (FIG. **1**B), while omitting one or more other components of the electronics **112**. In some embodiments, the NMD **120***a* includes additional components (e.g., one or more sensors, cameras, thermometers, barometers, hygrometers).

[0086] In some embodiments, an NMD can be integrated into a playback device. FIG. **1**G is a block diagram of a playback device **110***r* comprising an NMD **120***d*. The playback device **110***r* can comprise many or all of the components of the playback device **110***a* and further include the microphones **115** and voice processing **124** (FIG. **1**F). The playback device **110***r* optionally includes an integrated control device **130***c*. The control device **130***c* can comprise, for example, a user interface (e.g., the user interface **113** of FIG. **1**B) configured to receive user input (e.g., touch input, voice input) without a separate control device. In other embodiments, however, the playback device **110***r* receives commands from another control device (e.g., the control device **130***a* of FIG. **1**B).

[0087] Referring again to FIG. **1**F, the microphones **115** are configured to acquire, capture, and/or receive sound from an environment (e.g., the environment **101** of FIG. **1**A) and/or a room in which the NMD **120***a* is positioned. The received sound can include, for example, vocal utterances, audio played back by the NMD **120***a* and/or another playback device, background voices, ambient sounds, etc. The microphones **115** convert the received sound into electrical signals to produce microphone data. The voice processing **124** receives and analyzes the microphone data to determine whether a voice input is present in the microphone data. The voice input can comprise, for example, an activation word followed by an utterance including a user request. As those of ordinary skill in the art will appreciate, an activation word is a word or other audio cue that signifying a user voice input. For instance, in querying the AMAZON® VAS, a user might speak the activation word "Alexa." Other examples include "Ok, Google" for invoking the GOOGLE® VAS and "Hey, Siri" for invoking the APPLE® VAS.

[0088] After detecting the activation word, voice processing **124** monitors the microphone data for an accompanying user request in the voice input. The user request may include, for example, a command to control a third-party device, such as a thermostat (e.g., NEST® thermostat), an illumination device (e.g., a PHILIPS HUE® lighting device), or a media playback device (e.g., a Sonos® playback device). For example, a user might speak the activation word "Alexa" followed by the utterance "set the thermostat to 68 degrees" to set a temperature in a home (e.g., the environment **101** of FIG. **1**A). The user might speak the same activation word followed by the utterance "turn on the living room" to turn on illumination devices in a living room area of the home. The user may similarly speak an activation word followed by a request to play a particular song, an album, or a playlist of music on a playback device in the home.

d. Suitable Control Devices

[0089] FIG. **1**H is a partially schematic diagram of the control device **130***a* (FIGS. **1**A and **1**B). As used herein, the term "control device" can be used interchangeably with "controller" or "control system." Among other features, the control device **130***a* is configured to receive user input related to the media playback system **100** and, in response, cause one or more devices in the media playback system **100** to perform an action(s) or operation(s) corresponding to the user input. In the illustrated embodiment, the control device **130***a* includes a smartphone (e.g., an iPhone™, an Android phone) on which media playback system controller application software is installed. In some embodiments, the control device **130***a* includes, for example, a tablet (e.g., an iPad™), a computer (e.g., a laptop computer, a desktop computer), and/or another suitable device (e.g., a television, an automobile audio head unit, an IoT device). In certain embodiments, the control device **130***a* includes a dedicated controller for the media playback system **100**. In other embodiments, as described above with respect to FIG. **1**G, the control device **130***a* is integrated into another device in the media playback system **100** (e.g., one more of the playback devices **110**, NMDs **120**, and/or other suitable devices configured to communicate over a network).

[0090] The control device **130***a* includes electronics **132**, a user interface **133**, one or more speakers **134**, and one or more microphones **135**. The electronics **132** comprise one or more processors **132***a* (referred to hereinafter as "the processors **132***a*"), a memory **132***b*, software components **132***c*, and a network interface **132***d*. The processor **132***a* can be configured to perform functions relevant to facilitating user access, control, and configuration of the media playback system **100**. The memory **132***b* can comprise data storage that can be loaded with one or more of the software components executable by the processor **302** to perform those functions. The software components **132***c* can comprise applications and/or other executable software configured to facilitate control of the media playback system **100**. The memory **112***b* can be configured to store, for example, the software components **132***c*, media playback system controller application software, and/or other data associated with the media playback system **100** and the user.

[0091] The network interface **132***d* is configured to facilitate network communications between the control device **130***a* and one or more other devices in the media playback system **100**, and/or one or more remote devices. In some embodiments, the network interface **132** is configured to operate according to one or more suitable communication industry standards (e.g., infrared, radio, wired standards including IEEE 802.3, wireless standards including IEEE 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac, 802.15, 4G, LTE). The network interface **132***d* can be configured, for example, to transmit data to and/or receive data from the playback devices **110**, the NMDs **120**, other ones of the control devices **130**, one of the computing devices **106** of FIG. **1**B, devices comprising one or more other media playback systems, etc. The transmitted and/or received data can include, for example, playback device control commands, state variables, playback zone and/or zone group configurations. For instance, based on user input received at the user interface **133**, the network interface **132***d* can transmit a playback device control command (e.g., volume control, audio playback control, audio content selection) from the control device **304** to one or more of the playback devices **100**. The network interface **132***d* can also transmit and/or receive configuration changes such as, for example, adding/removing one or more playback devices **100** to/from a zone, adding/removing one or more zones to/from a zone group, forming a bonded or consolidated player, separating one or more playback devices from a bonded or consolidated player, among others. Additional description of zones and groups can be found below with respect to FIGS. **1**-I through **1**M.

[0092] The user interface **133** is configured to receive user input and can facilitate 'control of the media playback system **100**. The user interface **133** includes media content art **133***a* (e.g., album art, lyrics, videos), a playback status indicator **133***b* (e.g., an elapsed and/or remaining time indicator), media content information region **133***c*, a playback control region **133***d*, and a zone indicator **133***e*. The media content information region **133***c* can include a display of relevant information (e.g., title, artist, album, genre, release year) about media content currently playing and/or media content in a queue or playlist. The playback control region **133***d* can include selectable (e.g., via touch input and/or via a cursor or another suitable selector) icons to cause one or more playback devices in a selected playback zone or zone group to perform playback actions such as, for example, play or pause, fast forward, rewind, skip to next, skip to previous, enter/exit shuffle mode, enter/exit repeat mode, enter/exit cross fade mode, etc. The playback control region **133***d* may also include selectable icons to modify equalization settings, playback volume, and/or other suitable playback actions. In the illustrated embodiment, the user interface **133** includes a display presented on a touch screen interface of a smartphone (e.g., an iPhone™, an Android phone). In some embodiments, however, user interfaces of varying formats, styles, and interactive sequences may alternatively be implemented on one or more network devices to provide comparable control access to a media playback system.

[0093] The one or more speakers **134** (e.g., one or more transducers) can be configured to output sound to the user of the control device **130***a*. In some embodiments, the one or more speakers comprise individual transducers configured to correspondingly output low frequencies, mid-range frequencies, and/or high frequencies. In some aspects, for example, the control device **130***a* is configured as a playback device (e.g., one of the playback devices **110**). Similarly, in some embodiments the control device **130***a* is configured as

an NMD (e.g., one of the NMDs **120**), receiving voice commands and other sounds via the one or more microphones **135**.

[0094] The one or more microphones **135** can comprise, for example, one or more condenser microphones, electret condenser microphones, dynamic microphones, and/or other suitable types of microphones or transducers. In some embodiments, two or more of the microphones **135** are arranged to capture location information of an audio source (e.g., voice, audible sound) and/or configured to facilitate filtering of background noise. Moreover, in certain embodiments, the control device **130***a* is configured to operate as playback device and an NMD. In other embodiments, however, the control device **130***a* omits the one or more speakers **134** and/or the one or more microphones **135**. For instance, the control device **130***a* may comprise a device (e.g., a thermostat, an IoT device, a network device) comprising a portion of the electronics **132** and the user interface **133** (e.g., a touch screen) without any speakers or microphones. Additional control device embodiments are described in further detail below with respect to FIGS. **4**A-**4**D and **5**.

III. Example Wireless Earbud Charging System

[0095] As noted above, example implementations may involve a pair of earbuds. To illustrate, FIG. **2**A is a block diagram of an example earbud **210***a*. The earbud **210***a* may be used in a pair with another earbud **210** (e.g., an earbud **210***b*). As shown in the block diagram of FIG. **2**A, the earbud **210***a* includes several of the same or similar components as the playback device **110***a*. However, to facilitate portable use, the earbud **210***a* is implemented in an earbud form factor and includes an internal battery in power **212***i* to provide portable power.

[0096] The earbud **210***a* includes an input/output **211**, which can include an analog I/O **211***a* and/or a digital I/O **211***b* similar to the components of the playback device **110**. The earbud **210***a* further include electronics **212**, a user interface **213** (e.g., one or more buttons, knobs, dials, touch-sensitive surfaces, displays, touchscreens), and one or more transducers **214** (referred to hereinafter as "the transducers **214**"). The electronics **212** is configured to receive audio from an audio source via the input/output **211** and/or one or more of the computing devices **106***a-c* via the network **104** (FIG. **1**B)), amplify the received audio, and output the amplified audio for playback via one or more of the transducers **214**.

[0097] In some embodiments, the earbud **210***a* optionally includes one or more microphones **215** (e.g., a single microphone, a plurality of microphones, a microphone array) (hereinafter referred to as "the microphones **215**"). In certain embodiments, for example, the earbud **210***a* having one or more of the optional microphones **215** can operate as an NMD configured to receive voice input from a user and correspondingly perform one or more operations based on the received voice input.

[0098] In the illustrated embodiment of FIG. **2**A, the electronics **212** include one or more processors **212***a* (referred to hereinafter as "the processors **212***a*"), memory **212***b*, software components **212***c*, a network interface **212***d*, one or more audio processing components **212***g* (referred to hereinafter as "the audio components **212***g*"), one or more audio amplifiers **212***h* (referred to hereinafter as "the amplifiers **212***h*"), and power **212***i* (e.g., one or more power supplies, power cables, power receptacles, batteries, induction coils, Power-over Ethernet (POE) interfaces, and/or other suitable sources of electric power). In some embodiments, the electronics **212** optionally include one or more other components **212***j* (e.g., one or more sensors, video displays, touchscreens).

[0099] The network interface **212***d* is configured to facilitate a transmission of data between the earbud **210***a* and one or more other devices on a data network such as, for example, the links **103** and/or the network **104** (FIG. **1**B). The network interface **212***d* is configured to transmit and receive data corresponding to media content (e.g., audio content, video content, text, photographs) and other signals (e.g., non-transitory signals) comprising digital packet data including an Internet Protocol (IP)-based source address and/or an IP-based destination address. The network interface **212***d* can parse the digital packet data such that the electronics **212** properly receives and processes the data destined for the earbud **210***a*.

[0100] In the illustrated embodiment of FIG. **2**A, the network interface **212***d* includes an 802.15 interface **212***e* (referred to hereinafter as "the 802.15 interface **212***e*") and a 802.11 interface **212***f*. The network interface **212***d* (e.g., suitable interfaces comprising one or more antennae) can be configured to wirelessly communicate with one or more other devices (e.g., one or more of the playback devices **110**, NMDs **120**, control devices **130** that are communicatively coupled to the network **104** (FIG. **1**B) in accordance with a suitable wireless communication protocol (e.g., WiFi, LTE). Further, the network interface **212***d* can be configured to wirelessly communicate with an earbud **210***b* to form a pair of earbuds **210**.

[0101] In some embodiments, the network interface **212***d* optionally includes a wired interface (e.g., an interface or receptacle configured to receive a network cable such as an Ethernet, a USB-A, USB-C, and/or Thunderbolt cable) configured to communicate over a wired connection with other devices in accordance with a suitable wired communication protocol. In some embodiments, the electronics **212** excludes the network interface **212***d* altogether and transmits and receives media content and/or other data via another communication path (e.g., the input/output **711**).

[0102] The audio components **212***g* are configured to process and/or filter data comprising media content received by the electronics **212** (e.g., via the input/output **211** and/or the network interface **212***d*) to produce output audio signals. In some embodiments, the audio processing components **212***g* comprise, for example, one or more digital-to-analog converters (DAC), audio preprocessing components, audio enhancement components, a digital signal processors (DSPs), and/or other suitable audio processing components, modules, circuits, etc. In certain embodiments, one or more of the audio processing components **212***g* can comprise one or more subcomponents of the processors **212***a*. In some embodiments, the electronics **212** omits the audio processing components **212***g*. In some aspects, for example, the processors **212***a* execute instructions stored on the memory **212***b* to perform audio processing operations to produce the output audio signals.

[0103] The amplifiers **212***h* are configured to receive and amplify the audio output signals produced by the audio processing components **212***g* and/or the processors **212***a*. The amplifiers **212***h* can comprise electronic devices and/or components configured to amplify audio signals to levels sufficient for driving one or more of the transducers **214**. In

some embodiments, for example, the amplifiers **212***h* include one or more switching or class-D power amplifiers. In other embodiments, however, the amplifiers include one or more other types of power amplifiers (e.g., linear gain power amplifiers, class-A amplifiers, class-B amplifiers, class-AB amplifiers, class-C amplifiers, class-D amplifiers, class-E amplifiers, class-F amplifiers, class-G and/or class H amplifiers, and/or another suitable type of power amplifier). In certain embodiments, the amplifiers **212***h* comprise a suitable combination of two or more of the foregoing types of power amplifiers. Moreover, in some embodiments, individual ones of the amplifiers **212***h* correspond to individual ones of the transducers **214**. In other embodiments, however, the electronics **212** includes a single one of the amplifiers **212***h* configured to output amplified audio signals to a plurality of the transducers **214**.

[0104] The transducers **214** (e.g., one or more speakers and/or speaker drivers) receive the amplified audio signals from the amplifier **212***h* and render or output the amplified audio signals as sound (e.g., audible sound waves having a frequency between about 20 Hertz (Hz) and 20 kilohertz (kHz)). In some embodiments, the transducers **214** can comprise a single transducer. In other embodiments, however, the transducers **214** comprise a plurality of audio transducers. In some embodiments, the transducers **214** comprise more than one type of transducer. For example, the transducers **214** can include one or more low frequency transducers (e.g., subwoofers, woofers), mid-range frequency transducers (e.g., mid-range transducers, mid-woofers), and one or more high frequency transducers (e.g., one or more tweeters).

[0105] Within example implementations, the earbud **210***a* may operate in one of a first mode and a second mode. In the first mode, the earbud **210***a* operates independently of the media playback system **100**. While in the second mode, the earbud **210***a* operates as part of the media playback system **100**. Generally, the earbud **210***a* operates in the first mode while in the physical proximity of the media playback system **100** (e.g., while in the home) to facilitate interoperability with the playback device **110***a-n* of the media playback system **100** and operates in the second mode while "on the go," but the earbud **210***a* may also be operable in the second mode while in the physical proximity of the media playback system **100**. The portable playback device **710** may switch between modes manually (e.g., via user input to a user interface **213**) or automatically (e.g., based on proximity to one or more playback devices **110***a-n*).

[0106] In the first mode, the earbud **210***a* may interface with other devices of the media playback system **100**. For instance, the earbud **210***a* may form synchrony groupings or other arrangements with the playback devices **110***a-n* in the first mode. Further, in the first mode, the earbud **210***a* may be controlled by the control device(s) **130** in the same or similar manner as the playback device(s) **110**.

[0107] In the second mode, rather than operating as one playback device of the media playback system **100**, the earbud **210***a* operates independently. As noted above, this mode can be utilized "on the go" to facilitate playback away from the media playback system **100**. Further, this mode can be used in proximity to the media playback system **100**, which may facilitate more private use of the earbud **210***a*.

[0108] FIG. **2**B is a partial cutaway side view of the earbud **210***a* configured in accordance with aspects of the disclosed technology. As shown in FIG. **2**B, the earbud **210***a* includes a housing **216**. Various components of the earbud **210***a* may be carried in the housing **216**, such as the input/output **211**, the electronics **212**, the user interface **213**, and/or the transducers **214**.

[0109] A first portion of the housing **216** (labeled **216***a*) is insertable into an ear canal. The first portion **216***a* carries a first transducer **214***a* internally. The first transducer **214***a* is arranged in the first portion **216***a* to direct sound produced by the first transducer **214***a* into the ear canal when the first portion **216***a* is inserted in the ear canal.

[0110] A second portion of the housing (labeled **216***b*) carries a charging-adapter connection interface **217** (referred to herein as a connection interface **217**). The connection interface **217** includes magnets **218** (labelled individually as a first magnet **218***a* and a second magnet **218***b*). The magnets **218** attach a charging adapter **340***a* (FIG. **3**A) externally to the housing **216** of the earbud **210***a* (i.e., to the first portion **216***a*). Further, the magnets **218** align electrodes **219** of the earbud **210***a* with electrodes of the charging adapter **340***a* (FIG. **3**A). In alternate implementations, the connection interface may utilize mechanical connectors in addition to or as an alternative to the magnets **218**.

[0111] FIG. **3**A shows an example charging adapter **340***a* configured in accordance with aspects of the disclosed technology. The charging adapter **340***a* includes a housing **316**, which carries a power **312***i* that includes one or more adapter batteries. As shown, the housing **316** is substantially coin-shaped, which may facilitate attaching the charging adapter **340***a* to the earbud **210***a* and/or inserting the charging adapter **340***a* into a charging case **450** (FIGS. **4** and **6**).

[0112] The charging adapter **340***a* further includes magnets **318** (labelled individually as a first magnet **318***a*, a second magnet **318***b*, a third magnet **318***c*, and a fourth magnet **318***d*). The magnets **318***a* and **318***b* facilitate attachment of the charging adapter **340***a* to the connection interface **217** of the earbud **210***a*.

[0113] To illustrate, FIGS. **3**B and **3**C illustrate exemplary attachment of the charging adapter **340***a* to the earbud **210***a*. In particular, as illustrated in FIG. **3**B, the magnets **218***a* and **218***b* of the earbud **210***a* are attracted to the magnets **318***a* and **318***b*, respectively, of the charging adapter **340***a*. This magnetic attraction causes the charging adapter **340***a* to attach to the connection interface **217** of the earbud **210***a* when in proximity to the connection interface **217**.

[0114] FIG. **3**C shows the charging adapter **340***a* attached to the earbud **210***a*. When attached, the electrodes **219** of the earbud **210***a* are aligned with the electrodes **319***a* of the charging adapter **340***a* allowing current to be drawn from the adapter batteries of the charging adapter **340***a*. The earbud **210***a* uses this current to charge the battery or batteries of the power **212***i*.

[0115] In an example, a controller of the earbud **210***a* (which may be implemented via the processors **212***a*, the memory **212***b*, and the software components **212***b*) detects attachment of the first charging adapter to the magnetic interface, such as via completion of a circuit including the electrodes **219**. Based on detecting that the first charging adapter is attached to the magnetic interface, the controller causes the battery or batteries of the power **212***i* to charge from the charging adapter **340***a*. Charging the battery or batteries of the power **212***i* may involve drawing current from the one or more adapter batteries of the charging

adapter **340***a* via the electrodes **219** of the connection interface **217** and the electrodes **319***a* of the charging adapter **340**.

[0116] FIG. **4** shows an example charging case **450**. The charging case **450***a* includes a housing **416**, which carries a power **412***i*. The housing **416** forms a first volume **452***a* shaped to carry the charging adapter **340***a* and the earbud **210***a* when the charging adapter **340***a* and the earbud **210***a* are attached. The housing **416** also forms a second volume **452***b* shaped to carry a second charging adapter **340***b* and a second earbud **210***b* when the charging adapter **340***b* and the earbud **210***b* are attached.

[0117] The power **412***i* may include that includes one or more case batteries configured to charge the earbuds **210***a* and **210***b* and/or the charging adapters **340***a* and **340***b*. Further, the power **412***i* may include one or more coils. A wireless charger may induce a current in the one or more coils to wirelessly charge the one or more case batteries from wall power connected to the wireless charger. Additionally or alternatively, the power **412** may include a cable port. A cable connected between the cable port and a wall charger may deliver current to charge the one or more case batteries from wall power connected to the wall charger.

[0118] In the housing **416**, electrodes **419***a* are arranged to contact the electrodes **319***b* of the charging adapter **340***a* when the charging adapter **340***a* is carried in the first volume **452***a* formed by the housing **416**. To maintain the charging adapter **340***a* in the first volume **452***a*, the charging case **450***a* includes magnets **418***a* and **418***b*. Further, to maintain the earbud **210***a* in the first volume **452***a*, the charging case **450***a* optionally includes one or more magnets **418***e*. The magnets **218** of the earbud **210***a* and the magnets **318***a* and **318***b* of the charging adapter **340***a* may also or alternatively maintain the earbud **210***a* in the first volume **452***a*.

[0119] Similarly, in the housing **416**, electrodes **419***b* are arranged to contact the electrodes **319***b* of a second charging adapter **340***b* when the charging adapter **340***b* is carried in the second volume **452***b* formed by the housing **416**. To maintain the charging adapter **340***b* in the second volume **452***b*, the charging case **450***a* includes magnets **418***c* and **418***d*. Further, to maintain the earbud **210***b* in the second volume **452***a*, the charging case **450***a* optionally includes one or more magnets **418***f* However, similar to the earbud **210***a*, the magnets **218** of the earbud **210***b* and the magnets **318***a* and **318***b* of the charging adapter **340***b* may also or alternatively maintain the earbud **210***b* in the second volume **452***b*.

[0120] To illustrate, FIG. **5**A, **5**B, and **5**C illustrate example carrying of the earbuds **310***a* and **210***b* as well as the charging adapters **340***a* and **340***b* in the charging case **450***a*. FIG. **5**A illustrates how the magnets **418***a* and **418***b* align with the magnets **318***c* and **318***d* of the charging adapter **340***a*. Further, as described above, the magnets **318***a* and **318***b* align with the magnets **218***a* and **218***b* of the earbud **210***a*. Yet further, one or more magnets **218***c* align with the one or more magnets **418***e*.

[0121] When the earbud **210***a*, the charging adapter **340***a*, and the charging case **450***a* are brought into proximity while keeping the magnets **218**, **318**, and **418** aligned, the magnets **218**, **318**, and **418** maintain the charging adapter **340***a* and earbud **210***a* within the first volume **452***b*. Corresponding magnets maintain the charging adapter **340***b* and earbud **210***b* within the second volume **452***b*.

[0122] To illustrate, FIG. **5**B shows the charging adapters **340***a* and **340***b* carried in the first volume **452***a* and the second volume **452***b*. The charging adapters **340***a* and **340***b* are maintained in the first volume **452***a* and the second volume **452***b* via the magnets **318** and **418**, as shown.

[0123] FIG. **5**C shows the charging adapter **340***a* and the earbud **210***a* carried in the first volume **452***a* and the charging adapter **340***b* and the earbud **210***b* carried in the second volume **452***b*. The earbuds **210***a* and **210***b* and charging adapters **340***a* and **340***b* are maintained in the first volume **452***a* and the second volume **452***b* via the magnets **218**, **318** and **418**, as shown. A cover **416***a* may optionally be placed on or connected to the housing **416**.

[0124] FIG. **5**D illustrates how the earbud **210***a* and charging adapter **340***a* may be inserted into the charging case **450***a* while attached to one another. Similar, the earbud **210***b* and charging adapter **340***b* may be inserted into the charging case **450***a* while attached to one another. In some embodiments, the charging adapters **340***a* and **340***b* are interchangeable between the earbuds **310***a* and **310***b*. Further, in such examples, the charging adapters **340***a* and **340***b* may be carried in either the first volume **452***a* or the second volume **452***b*.

[0125] Carrying the earbuds **210***a* and **210***b* and charging adapters **340***a* and **340***b* as shown in FIGS. **5**A, **5**B, **5**C, and **5**D facilities charging of the earbuds **210***a* and **210***b* and/or the charging adapters **340***a* and **340***b*. In particular, when the charging adapter **340***a* is carried in the charging case **450***a* as shown in FIGS. **5**B and **5**C, the electrodes **319***b* of the charging adapter **340***a* align and contact the electrodes **419***a* of the charging case **450***a*. This allows the charging adapter **340***a* to draw current from the case batteries of the charging case **450***a* or wall power (e.g., if the charging case is connected to wall power). The charging adapter **340***b* may charge similarly using the electrodes **419***b*.

[0126] Similarly, when the earbud **210***a* is carried in the charging case **450***a* as shown in FIG. **5**C, the electrodes **319***a* of the charging adapter **340***a* align and contact the electrodes **218***b* of the charging case **450***a*. This allows the earbud **210***a* to draw current from the charging adapter **340***a*. In some embodiments, the earbud **210***a* charges from the adapter batteries of the charging adapter **340***a* (which may be concurrently or later recharged using the case batteries of the charging case **450***a* or wall power). Alternatively, the charging adapter **340***a* may direct current from the electrodes **419***a* through the electrodes **319***b* and **318***a* to the electrodes **218***a* of the earbud **210***a*. The earbud **210***b* may charge similarly when carried in the volume **252***b*.

[0127] FIG. **6**A shows another example charging case **650**. Like the charging case **450**, the charging case **650** includes a housing **616** carrying a power **612** that includes one or more case batteries. Further, the housing **616** forms a first volume **652***a* configured to carry the earbud **210***a* and the charging adapter **340***a*, as well as the corresponding electrodes **619***a* and magnets **618***a*, **618***b*, and **618***e*. Yet further, the housing **616** forms a second volume **652***b* configured to carry the earbud **210***b* and the charging adapter **340***b*, as well as the corresponding electrodes **619***b* and magnets **618***c*, **618***d*, and **618***f*.

[0128] In contrast to the charging case **450**, the housing of the charging case **650** forms a third volume **652***c* and a fourth volume **652***d*. The third volume **652***c* is formed to carry a third charging adapter **340***c* while the fourth volume **652***d* is formed to carry a fourth charging adapter **340***d*.

Magnets **618***g* and **618***h* maintain the third charging adapter **340***c* in the third volume **652**. While the third charging adapter **340***c* is carried in the third volume **652***c*, the electrodes **619***c* align with and connect with electrodes of the third charging adapter **340***c*, allowing the third charging adapter **340***c* to charge from the case batteries or wall power. Similarly, magnets **618***i* and **618***k* maintain the fourth charging adapter **340***d* in the fourth volume **652***d*. While the fourth charging adapter **340***d* is carried in the third volume **652***d*, the electrodes **619***d* align with and connect with electrodes of the fourth charging adapter **340***d*, allowing the fourth charging adapter **340***d* to charge from the case batteries or wall power. If the charging adapters **340***a* and **340***b* become drained, a user can swap out the charging adapters **340***c* and **340***d* to continue charging the earbuds **210** without necessarily interrupting playback.

[0129] FIG. **6**B shows a partial cutaway side view of a pair of earbuds **710** (labelled as earbud **710***a* and **710***b*), a first charging adapter **740***a*, a second charging adapter **740***b*, and a charging case **750**. The earbuds **710**, the charging adapters **740***a* and **740***b*, and the charging case **750** generally function similarly as the earbuds **210**, charging adapters **340**, and charging cases **450** and **650**.

[0130] As shown in FIG. **6**B, a housing **716** carries a power **712** that includes one or more case batteries. Further, the housing **716** of the charging case **750** forms a first volume **752***a* and a second volume **752***b*. The first volume **752***a* is configured to carry the earbud **710***a* while the second volume **752***b* is formed to carry the earbud **710***b*. Magnets in the housing **716** and/or a connection interface **717***a* of the earbud **710***a* maintain the earbud **710***a* in the first volume **752***a*. Similarly, magnets in the housing **716** and/or a connection interface **717***b* of the earbud **710***b* maintain the earbud **710***b* in the second volume **752***b*. Further, the magnets and the shape of the first volume **752***a* align electrodes of the connection interface **717***a* with corresponding electrodes in the housing **716**, allowing the earbud **710***a* to charge from the case batteries of the power **712**. The earbud **710***b* can likewise charge when carried in the second volume **752***b*, as shown.

[0131] Yet further, as also shown in FIG. **6**B, the charging adapter **740***a* is attachable to the earbud **710***a* via a connection interface **717***c*. Similarly, the charging adapter **740***b* is attachable to the earbud **710***b* via a connection interface **717***d*. Each of the charging adapters **740***a* and **740***b* can charge the corresponding earbuds **710***a* and **710***b* when attached to the earbuds **710***a* and **710***b* (and not carried in the charging case **750**). Further, each of the charging adapters **740***a* and **740***b* can be charged by the one or more case batteries (or wall power delivered through the charging case **750**) via the earbud **710***a* or the earbud **710***b* (i.e., through the electrodes of the connection interfaces **717***a* and **717***c* or the connection interfaces **717***b* and **717***d*) when attached to the earbuds **710***a* and **710***b* (and the earbuds **710** are carried in the charging case **750**).

[0132] In further embodiments, example earbuds utilize charging adapters as internal battery packs. In such examples, the charging adapters may be removable and swapped with (charged) charging adapters from the charging case. Other examples are possible as well.

[0133] Yet further, in some examples, example charging adapters may be attached to other portable playback devices, such as headphones. For instance, example headphones may include similar connection interfaces as the earbuds. By attaching a charging adapter to the headphones, internal batteries of the headphones may be charged from the adapter batteries of the charging adapter.

[0134] In further examples, the charging adapter may include an around the ear clip to support the additional mass of the charging adapter. In such examples, attaching the charging adapter to an earbud may arrange the ear clip to be supported by the ear lobe when the ear bud is inserted in the ear canal. Other examples are possible as well.

IV. Example Charging Techniques

[0135] FIG. **7** is a flow diagram showing an example method **700** facilitate charging of one or more wireless earbuds. The method **700** may be performed by an earbud, such as the earbud **210***a* (FIG. **2**A). Alternatively, the method **700** may be performed by any suitable device or by a system of devices, such as a system comprising the pair of earbuds **710**, among other examples.

[0136] At block **702**, the method **700** includes detecting attachment of a first charging adapter to a magnetic interface. For instance, the earbud **210***a* may detect attachment of the charging adapter **340***a* using the magnets **218** and **318** (FIG. **3**B) using the electronics **210** (FIG. **2**A). As another example, the earbud **740***a* may detect attachment of the charging adapter **740***a* (FIG. **6**B). In some examples, a second earbud (e.g., the earbud **210***b*) may detect attachment of a second charging adapter **340***b*.

[0137] At block **704**, the method **700** includes causing a first internal battery to charge from the first charging adapter. For example, the earbud **210***a* may cause the internal battery in power **212***i* (FIG. **2**A) to charge from the charging adapter **340***a* (FIG. **3**D). Charging the first internal battery may involve drawing current from the one or more adapter batteries of the first charging adapter via the electrodes (e.g., the electrodes **219**) of the magnetic connection interface and the electrodes of the first charging adapter (e.g., the electrodes **319**) (FIG. **3**D). In some examples, a second earbud (e.g., the earbud **210***b*) may cause a second internal battery to charge from a second charging adapter (e.g., the charging adapter **340***b*), When the first charging adapter **340***a* is detached from the magnetic interface, the earbud **210***a* stops charging.

[0138] At block **706**, the method **700** includes playing back audio content. For instance, the earbud **210***a*, possibly in a stereo pair with another earbud (e.g., the earbud **210***b*), may play back audio content. Playing back audio content may involve streaming data representing audio from a remote source using the network interface **212***d*, processing the audio using the processors **212***a* and/or the audio processing components **212***g*, and outputting the audio using the transducers **214** (FIG. **2**A). During playback, the components of the earbud **210***a* may be powered by the internal battery of the power **212***i*, which may be charging from the charging adapter.

[0139] In some cases, the method **700** further involves detecting that a battery level of the internal battery is below a threshold level. Based on such detecting, the earbud **210***a* may output an indication that the battery level is low. For instance, the earbud **210***a* may play back an audible notification that the battery level is low and that the user should attach a charging adapter to continue use of the earbud **210***a*.

V. Additional Examples

[0140] FIG. **8**A is a front isometric view of earbuds **810** including an earbud **810***a* and an earbud **810***b* configured in accordance with aspects of the disclosed technology. As shown, the earbuds **800** are carried in a charging case **850**.

[0141] FIG. **8**B is a bottom view of the charging case **850**.

[0142] FIG. **8**C is a top view of the charging case **850**.

[0143] FIG. **8**D is a first side view of the charging case **850**.

[0144] FIG. **8**E is a second side view of the charging case **850**.

[0145] FIG. **8**F is a front isometric view of the earbud **810***a* and the earbud **810***b* illustrating exemplary arrangement with the charging case **850**. A charging adapter **840***a* is attached to an exterior surface of the earbud **810***a*, as shown. Similarly, a charging adapter **840***b* is attached to an exterior surface of the earbud **810***b*, as also shown.

[0146] FIG. **8**G is an isometric view of the earbud **810***a* and the charging adapter **840***a*.

[0147] FIG. **8**H is a first side view of the earbud **810***a* and the charging adapter **840***a*.

[0148] FIG. **8**I is a second side view of the earbud **810***a* and the charging adapter **840***a*.

[0149] FIG. **8**J is a third side view of the earbud **810***a* and the charging adapter **840***a*.

[0150] FIG. **8**K is a fourth side view of the earbud **810***a* and the charging adapter **840***a*.

[0151] FIG. **8**L is a fifth side view of the earbud **810***a*.

[0152] FIG. **8**M is a sixth side view of the earbud **810***a*.

[0153] FIG. **9**A is a front view of headphones **910** configured in accordance with aspects of the disclosed technology.

[0154] FIG. **9**B is a first side view of the headphones **910**. A charging adapter **940***a* is attached to a first exterior surface of the headphones **910**, as shown.

[0155] FIG. **9**B is a second side view of the headphones **910**. A charging adapter **940***b* is attached to a second exterior surface of the headphones **910**, as also shown.

VI. Conclusion

[0156] The above discussions relating to playback devices, controller devices, playback zone configurations, and media content sources provide only some examples of operating environments within which functions and methods described below may be implemented. Other operating environments and configurations of media playback systems, playback devices, and network devices not explicitly described herein may also be applicable and suitable for implementation of the functions and methods.

[0157] The description above discloses, among other things, various example systems, methods, apparatus, and articles of manufacture including, among other components, firmware and/or software executed on hardware. It is understood that such examples are merely illustrative and should not be considered as limiting. For example, it is contemplated that any or all of the firmware, hardware, and/or software aspects or components can be embodied exclusively in hardware, exclusively in software, exclusively in firmware, or in any combination of hardware, software, and/or firmware. Accordingly, the examples provided are not the only ways) to implement such systems, methods, apparatus, and/or articles of manufacture.

[0158] Additionally, references herein to "embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment can be included in at least one example embodiment of an invention. The appearances of this phrase in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. As such, the embodiments described herein, explicitly and implicitly understood by one skilled in the art, can be combined with other embodiments.

[0159] The specification is presented largely in terms of illustrative environments, systems, procedures, steps, logic blocks, processing, and other symbolic representations that directly or indirectly resemble the operations of data processing devices coupled to networks. These process descriptions and representations are typically used by those skilled in the art to most effectively convey the substance of their work to others skilled in the art. Numerous specific details are set forth to provide a thorough understanding of the present disclosure. However, it is understood to those skilled in the art that certain embodiments of the present disclosure can be practiced without certain, specific details. In other instances, well known methods, procedures, components, and circuitry have not been described in detail to avoid unnecessarily obscuring aspects of the embodiments. Accordingly, the scope of the present disclosure is defined by the appended claims rather than the foregoing description of embodiments.

[0160] When any of the appended claims are read to cover a purely software and/or firmware implementation, at least one of the elements in at least one example is hereby expressly defined to include a tangible, non-transitory medium such as a memory, DVD, CD, Blu-ray, and so on, storing the software and/or firmware.

[0161] The present technology is illustrated, for example, according to various aspects described below. Various examples of aspects of the present technology are described as numbered examples (1, 2, 3, etc.) for convenience. These are provided as examples and do not limit the present technology. It is noted that any of the dependent examples may be combined in any combination, and placed into a respective independent example. The other examples can be presented in a similar manner.

EXAMPLE 1

[0162] A system comprising: a first charging adapter comprising one or more adapter batteries; and a first earbud, the first earbud comprising: a first IEEE 802.15-compatible interface; a first internal battery; a first audio driver; a housing carrying the first IEEE 802.15-compatible interface and the first internal battery, wherein the housing of the first earbud comprises: a first portion insertable into a first ear canal, the first portion carrying the first audio driver; and a second portion carrying a magnetic interface that includes one or more magnets that (i) attach the first charging adapter externally to the housing of the first earbud and (ii) align electrodes of the first charging adapter to electrodes of the magnetic interface; and a first controller carried in the housing of the first earbud and configured to perform functions comprising: detecting attachment of the first charging adapter to the magnetic interface; and based on detecting that the first charging adapter is attached to the magnetic interface, causing the first internal battery to

charge from the first charging adapter, wherein charging the first internal battery comprises drawing current from the one or more adapter batteries of the first charging adapter via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter.

EXAMPLE 2

[0163] The system of example 1, further comprising: a second charging adapter comprising one or more adapter batteries; and a second earbud, the second earbud comprising: a second IEEE 802.15-compatible interface; a second internal battery; a second audio driver; a housing carrying the second IEEE 802.15-compatible interface and the second internal battery, wherein the housing of the second earbud comprises: a first portion insertable into a second ear canal, the first portion carrying the second audio driver; and a second portion carrying a magnetic interface that includes one or more magnets that (i) attach the second charging adapter externally to the housing of the second earbud and (ii) align electrodes of the second charging adapter to electrodes of the magnetic interface; a second controller carried in the housing of the second earbud and configured to perform functions comprising: detecting attachment of the second charging adapter to the magnetic interface; and based on detecting that the second charging adapter is attached to the magnetic interface, causing the second internal battery to charge from the second charging adapter, wherein charging the second internal battery comprises drawing current from the one or more adapter batteries of the second charging adapter via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

EXAMPLE 3

[0164] The system of example 2, further comprising a charging case, the charging case comprising: one or more case batteries; and a housing carrying the one or more case batteries, the housing comprising: a first portion forming a first volume shaped to carry the first charging adapter and the first earbud when the first charging adapter and the first earbud are attached; first electrodes arranged in the housing to contact the electrodes of the first charging adapter when the first charging adapter is carried in the housing of the charging case, wherein the one or more adapter batteries of the first charging adapter and the first internal battery of the first earbud charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter; a second portion forming a second volume shaped to carry the second charging adapter and the second earbud when the second charging adapter and the second earbud are attached; and second electrodes arranged in the housing to contact the electrodes of the second charging adapter when the second charging adapter is carried in the housing of the charging case, wherein the one or more adapter batteries of the second charging adapter and the second internal battery of the second earbud charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the second earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

EXAMPLE 4

[0165] The system of example 3, further comprising: a third charging adapter substantially similar to the first charging adapter; and a fourth charging adapter substantially similar to the second charging adapter, wherein the housing of the charging case further comprises: a third portion forming a third volume shaped to carry the third charging adapter; third electrodes arranged in the housing to contact electrodes of the third charging adapter when the third charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the third charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power; a fourth portion forming a fourth volume shaped to carry the fourth charging adapter; and fourth electrodes arranged in the housing to contact electrodes of the fourth charging adapter when the fourth charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the fourth charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power.

EXAMPLE 5

[0166] The system of example 3, wherein the charging case further comprises (i) one or more coils, wherein a wireless charger induces a current in the one or more coils to wirelessly charge the one or more case batteries from wall power connected to the wireless charger and (ii) a cable port, wherein a cable connected between the cable port and a wall charger delivers current to charge the one or more case batteries from wall power connected to the wall charger.

EXAMPLE 6

[0167] The system of example 2, further comprising a charging case, the charging case comprising: one or more case batteries; and a housing carrying the one or more case batteries, the housing comprising: a first portion forming a first volume shaped to carry the first earbud; first electrodes arranged in the housing to contact the electrodes of the first earbud when the first earbud is carried in the housing of the charging case, wherein the first internal battery of the first earbud charges from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power; a second portion forming a second volume shaped to carry the first charging adapter; and second electrodes arranged in the housing to contact the electrodes of the first charging adapter when the first charging adapter is carried in the housing of the charging case, wherein the one or more adapter batteries of the first charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power; a third portion forming a third volume shaped to carry the second earbud; third electrodes arranged in the housing to contact the electrodes of the second earbud when second earbud is carried in the housing of the charging case, wherein the

second internal battery of the second earbud charges from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power; a fourth portion forming a fourth volume shaped to carry the second charging adapter; and fourth electrodes arranged in the housing to contact the electrodes of the second charging adapter when the second charging adapter is carried in the housing of the charging case, wherein the one or more adapter batteries of the second charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power.

EXAMPLE 7

[0168] The system of example 5, further comprising: a third charging adapter substantially similar to the first charging adapter; and a fourth charging adapter substantially similar to the second charging adapter, wherein the housing of the charging case further comprises: a fifth portion forming a fifth volume shaped to carry the third charging adapter; fifth electrodes arranged in the housing to contact electrodes of the third charging adapter when the third charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the third charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power; a sixth portion forming a sixth volume shaped to carry the fourth charging adapter; and sixth electrodes arranged in the housing to contact electrodes of the fourth charging adapter when the fourth charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the fourth charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power.

EXAMPLE 8

[0169] The system of example 2, wherein the first charging adapter and the second charging adapter are interchangeable between the first earbud and the second earbud.

EXAMPLE 9

[0170] The system of example 8, wherein the housings of the first charging adapter and the second charging adapter are substantially coin-shaped

EXAMPLE 10

[0171] The system of example 2, wherein the first internal battery of the first earbud and the second internal battery of the second earbud are removeable, wherein the first charging adapter is swappable with the first internal battery, and wherein the second charging adapter is swappable with the second internal battery.

EXAMPLE 11

[0172] The system of example 1, wherein the system further comprises wireless headphones, the wireless headphones comprising: a third IEEE 802.15-compatible interface; a third internal battery; two or more third audio drivers; a housing carrying the first IEEE 802.15-compatible interface and the first internal battery, wherein the housing of the wireless headphones comprises: a first portion carrying a magnetic interface that includes one or more magnets that (i) attach the first charging adapter externally to the housing of the wireless headphones and (ii) align electrodes of the first charging adapter to electrodes of the magnetic interface.

EXAMPLE 12

[0173] A first charging adapter comprising: one or more adapter batteries; and a housing carrying the one or more adapter batteries and a magnetic interface that includes one or more magnets that (i) attach the first charging adapter externally to a housing of a first earbud and (ii) align electrodes of the first charging adapter to electrodes of the first earbud, wherein a first internal battery of the first earbud charges from the first charging adapter when the first charging adapter is attached to the housing of the first earbud via the magnetic interface, wherein the first earbud draws current from the one or more adapter batteries of the first charging adapter via the electrodes of the magnetic connection interface and the electrodes of the first earbud.

EXAMPLE 13

[0174] The first charging adapter of example 12, wherein the housing of the first charging adapter is formed to be carried within a volume in a housing of a charging case, wherein the electrodes of the first charging adapter contact first electrodes arranged in the housing of the charging case when the first charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the first charging adapter and the first internal battery of the first earbud charge from (a) one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first earbud.

EXAMPLE 14

[0175] The first charging adapter of example 12, wherein the housing of the first charging adapter is formed to be carried within a volume in a housing of a charging case, wherein the electrodes of the first charging adapter contact first electrodes arranged in the housing of the charging case when the first charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the first charging adapter charge from (a) one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first charging adapter draws current via the electrodes of the magnetic interface and the first electrodes arranged in the housing of the charging case.

EXAMPLE 15

[0176] The first charging adapter of example 12, wherein the housing of the first charging adapter is substantially coin-shaped.

EXAMPLE 16

[0177] The first charging adapter of example 12, wherein the first internal battery of the first earbud is removeable, and wherein the first charging adapter is swappable with the first internal battery.

EXAMPLE 17

[0178] A pair of wireless earbuds comprising a first earbud and a second earbud, the first earbud comprising: a first IEEE 802.15-compatible interface; a first internal battery; a first audio driver; a housing carrying the first IEEE 802.15-compatible interface and the first internal battery, wherein the housing of the first earbud comprises: a first portion insertable into a first ear canal, the first portion carrying the first audio driver; and a second portion carrying a magnetic interface that includes one or more magnets that (i) attach a first charging adapter externally to the housing of the first earbud and (ii) align electrodes of the first charging adapter to electrodes of the magnetic interface; and a first controller carried in the housing of the first earbud and configured to perform functions comprising: detecting attachment of the first charging adapter to the magnetic interface; and based on detecting that the first charging adapter is attached to the magnetic interface, causing the first internal battery to charge from the first charging adapter, wherein charging the first internal battery comprises drawing current from one or more adapter batteries of the first charging adapter via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter; and the second earbud comprising: a second IEEE 802.15-compatible interface; a second internal battery; a second audio driver; a housing carrying the second IEEE 802.15-compatible interface and the second internal battery, wherein the housing of the second earbud comprises: a first portion insertable into a second ear canal, the first portion carrying the second audio driver; and a second portion carrying a magnetic interface that includes one or more magnets that (i) attach a second charging adapter externally to the housing of the second earbud and (ii) align electrodes of the second charging adapter to electrodes of the magnetic interface; a second controller carried in the housing of the second earbud and configured to perform functions comprising: detecting attachment of the second charging adapter to the magnetic interface; and based on detecting that the second charging adapter is attached to the magnetic interface, causing the second internal battery to charge from the second charging adapter, wherein charging the second internal battery comprises drawing current from one or more adapter batteries of the second charging adapter via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

EXAMPLE 18

[0179] The pair of wireless earbuds of example 17, wherein: the housing of the first earbud is formed to be carried within a first volume in a housing of a charging case while attached to the first charging adapter, wherein the electrodes of the first charging adapter contact first electrodes arranged in the housing of the charging case when the first charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the first charging adapter and the first internal battery of the first earbud charge from (a) one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter; and the housing of the second earbud is formed to be carried within a second volume in the housing of the charging case while attached to the second charging adapter, wherein the electrodes of the second charging adapter contact second electrodes arranged in the housing of the charging case when the second charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the second charging adapter and the second internal battery of the second earbud charge from (a) the one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the second earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

EXAMPLE 19

[0180] The pair of wireless earbuds of example 17, wherein: the housing of the first earbud is formed to be carried within a first volume in a housing of a charging case while attached to the first charging adapter, wherein the electrodes of the first charging adapter contact first electrodes arranged in the housing of the charging case when the first charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the first charging adapter and the first internal battery of the first earbud charge from (a) one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter; and the housing of the second earbud is formed to be carried within a second volume in the housing of the charging case while attached to the second charging adapter, wherein the electrodes of the second charging adapter contact second electrodes arranged in the housing of the charging case when the second charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the second charging adapter and the second internal battery of the second earbud charge from (a) the one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the second earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

EXAMPLE 20

[0181] The pair of wireless earbuds of example 17, wherein the first charging adapter and the second charging adapter are interchangeable between the first earbud and the second earbud.

EXAMPLE 21

[0182] The pair of wireless earbuds of example 17, wherein the first internal battery of the first earbud and the second internal battery of the second earbud are removeable, wherein the first charging adapter is swappable with the first internal battery, and wherein the second charging adapter is swappable with the second internal battery.

EXAMPLE 22

[0183] A charging case comprising: one or more case batteries; and a housing carrying the one or more case

batteries, the housing comprising: a first portion forming a first volume shaped to carry a first charging adapter and a first earbud when the first charging adapter and the first earbud are attached; first electrodes arranged in the housing to contact electrodes of the first charging adapter when the first charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the first charging adapter and a first internal battery of the first earbud charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter; a second portion forming a second volume shaped to carry a second charging adapter and a second earbud when the second charging adapter and the second earbud are attached; and second electrodes arranged in the housing to contact electrodes of the second charging adapter when the second charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the second charging adapter and a second internal battery of the second earbud charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the second earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

EXAMPLE 23

[0184] The charging case of example 22, further comprising: a third portion forming a third volume shaped to carry a third charging adapter; third electrodes arranged in the housing to contact electrodes of the third charging adapter when the third charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the third charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power; a fourth portion forming a fourth volume shaped to carry a fourth charging adapter; and fourth electrodes arranged in the housing to contact electrodes of the fourth charging adapter when the fourth charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the fourth charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power.

EXAMPLE 24

[0185] The charging case of example 22, wherein the charging case further comprises (i) one or more coils, wherein a wireless charger induces a current in the one or more coils to wirelessly charge the one or more case batteries from wall power connected to the wireless charger and (ii) a cable port, wherein a cable connected between the cable port and a wall charger delivers current to charge the one or more case batteries from wall power connected to the wall charger.

We claim:

1. A system comprising:

a first charging adapter comprising one or more adapter batteries; and

a first earbud, the first earbud comprising:

a first IEEE 802.15-compatible interface;

a first internal battery;

a first audio driver;

a housing carrying the first IEEE 802.15-compatible interface and the first internal battery, wherein the housing of the first earbud comprises:

a first portion insertable into a first ear canal, the first portion carrying the first audio driver; and

a second portion carrying a magnetic interface that includes one or more magnets that (i) attach the first charging adapter externally to the housing of the first earbud and (ii) align electrodes of the first charging adapter to electrodes of the magnetic interface; and

a first controller carried in the housing of the first earbud and configured to perform functions comprising:

detecting attachment of the first charging adapter to the magnetic interface; and

based on detecting that the first charging adapter is attached to the magnetic interface, causing the first internal battery to charge from the first charging adapter, wherein charging the first internal battery comprises drawing current from the one or more adapter batteries of the first charging adapter via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter.

2. The system of claim **1**, further comprising:

a second charging adapter comprising one or more adapter batteries; and

a second earbud, the second earbud comprising:

a second IEEE 802.15-compatible interface;

a second internal battery;

a second audio driver;

a housing carrying the second IEEE 802.15-compatible interface and the second internal battery, wherein the housing of the second earbud comprises:

a first portion insertable into a second ear canal, the first portion carrying the second audio driver; and

a second portion carrying a magnetic interface that includes one or more magnets that (i) attach the second charging adapter externally to the housing of the second earbud and (ii) align electrodes of the second charging adapter to electrodes of the magnetic interface;

a second controller carried in the housing of the second earbud and configured to perform functions comprising:

detecting attachment of the second charging adapter to the magnetic interface; and

based on detecting that the second charging adapter is attached to the magnetic interface, causing the second internal battery to charge from the second charging adapter, wherein charging the second internal battery comprises drawing current from the one or more adapter batteries of the second charging adapter via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

3. The system of claim 2, further comprising a charging case, the charging case comprising:

one or more case batteries; and

a housing carrying the one or more case batteries, the housing comprising:

a first portion forming a first volume shaped to carry the first charging adapter and the first earbud when the first charging adapter and the first earbud are attached;

first electrodes arranged in the housing to contact the electrodes of the first charging adapter when the first charging adapter is carried in the housing of the charging case, wherein the one or more adapter batteries of the first charging adapter and the first internal battery of the first earbud charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter;

a second portion forming a second volume shaped to carry the second charging adapter and the second earbud when the second charging adapter and the second earbud are attached; and

second electrodes arranged in the housing to contact the electrodes of the second charging adapter when the second charging adapter is carried in the housing of the charging case, wherein the one or more adapter batteries of the second charging adapter and the second internal battery of the second earbud charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the second earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

4. The system of claim 3, further comprising:

a third charging adapter substantially similar to the first charging adapter; and

a fourth charging adapter substantially similar to the second charging adapter,

wherein the housing of the charging case further comprises:

a third portion forming a third volume shaped to carry the third charging adapter;

third electrodes arranged in the housing to contact electrodes of the third charging adapter when the third charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the third charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power;

a fourth portion forming a fourth volume shaped to carry the fourth charging adapter; and

fourth electrodes arranged in the housing to contact electrodes of the fourth charging adapter when the fourth charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the fourth charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power.

5. The system of claim 3, wherein the charging case further comprises (i) one or more coils, wherein a wireless charger induces a current in the one or more coils to wirelessly charge the one or more case batteries from wall power connected to the wireless charger and (ii) a cable port, wherein a cable connected between the cable port and a wall charger delivers current to charge the one or more case batteries from wall power connected to the wall charger.

6. The system of claim 2, further comprising a charging case, the charging case comprising:

one or more case batteries; and

a housing carrying the one or more case batteries, the housing comprising:

a first portion forming a first volume shaped to carry the first earbud;

first electrodes arranged in the housing to contact the electrodes of the first earbud when the first earbud is carried in the housing of the charging case, wherein the first internal battery of the first earbud charges from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power;

a second portion forming a second volume shaped to carry the first charging adapter; and

second electrodes arranged in the housing to contact the electrodes of the first charging adapter when the first charging adapter is carried in the housing of the charging case, wherein the one or more adapter batteries of the first charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power;

a third portion forming a third volume shaped to carry the second earbud;

third electrodes arranged in the housing to contact the electrodes of the second earbud when second earbud is carried in the housing of the charging case, wherein the second internal battery of the second earbud charges from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power;

a fourth portion forming a fourth volume shaped to carry the second charging adapter; and

fourth electrodes arranged in the housing to contact the electrodes of the second charging adapter when the second charging adapter is carried in the housing of the charging case, wherein the one or more adapter batteries of the second charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power.

7. The system of claim 5, further comprising:

a third charging adapter substantially similar to the first charging adapter; and

a fourth charging adapter substantially similar to the second charging adapter,

wherein the housing of the charging case further comprises:

a fifth portion forming a fifth volume shaped to carry the third charging adapter;

fifth electrodes arranged in the housing to contact electrodes of the third charging adapter when the third charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the third charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power;

a sixth portion forming a sixth volume shaped to carry the fourth charging adapter; and

sixth electrodes arranged in the housing to contact electrodes of the fourth charging adapter when the fourth charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the fourth charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power.

8. The system of claim **2**, wherein the first charging adapter and the second charging adapter are interchangeable between the first earbud and the second earbud.

9. The system of claim **8**, wherein the housings of the first charging adapter and the second charging adapter are substantially coin-shaped.

10. The system of claim **2**, wherein the first internal battery of the first earbud and the second internal battery of the second earbud are removeable, wherein the first charging adapter is swappable with the first internal battery, and wherein the second charging adapter is swappable with the second internal battery.

11. The system of claim **1**, wherein the system further comprises wireless headphones, the wireless headphones comprising:

a third IEEE 802.15-compatible interface;

a third internal battery;

two or more third audio drivers;

a housing carrying the first IEEE 802.15-compatible interface and the first internal battery, wherein the housing of the wireless headphones comprises:

a first portion carrying a magnetic interface that includes one or more magnets that (i) attach the first charging adapter externally to the housing of the wireless headphones and (ii) align electrodes of the first charging adapter to electrodes of the magnetic interface.

12. A first charging adapter comprising:

one or more adapter batteries; and

a housing carrying the one or more adapter batteries and a magnetic interface that includes one or more magnets that (i) attach the first charging adapter externally to a housing of a first earbud and (ii) align electrodes of the first charging adapter to electrodes of the first earbud, wherein a first internal battery of the first earbud charges from the first charging adapter when the first charging adapter is attached to the housing of the first earbud via the magnetic interface, wherein the first earbud draws current from the one or more adapter batteries of the first charging adapter via the electrodes of the magnetic connection interface and the electrodes of the first earbud.

13. The first charging adapter of claim **12**, wherein the housing of the first charging adapter is formed to be carried within a volume in a housing of a charging case, wherein the electrodes of the first charging adapter contact first electrodes arranged in the housing of the charging case when the first charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the first charging adapter and the first internal battery of the first earbud charge from (a) one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first earbud.

14. The first charging adapter of claim **12**, wherein the housing of the first charging adapter is formed to be carried within a volume in a housing of a charging case, wherein the electrodes of the first charging adapter contact first electrodes arranged in the housing of the charging case when the first charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the first charging adapter charge from (a) one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first charging adapter draws current via the electrodes of the magnetic interface and the first electrodes arranged in the housing of the charging case.

15. The first charging adapter of claim **12**, wherein the housing of the first charging adapter is substantially coin-shaped.

16. The first charging adapter of claim **12**, wherein the first internal battery of the first earbud is removeable, and wherein the first charging adapter is swappable with the first internal battery.

17. A pair of wireless earbuds comprising a first earbud and a second earbud,

the first earbud comprising:

a first IEEE 802.15-compatible interface;

a first internal battery;

a first audio driver;

a housing carrying the first IEEE 802.15-compatible interface and the first internal battery, wherein the housing of the first earbud comprises:

a first portion insertable into a first ear canal, the first portion carrying the first audio driver; and

a second portion carrying a magnetic interface that includes one or more magnets that (i) attach a first charging adapter externally to the housing of the first earbud and (ii) align electrodes of the first charging adapter to electrodes of the magnetic interface; and

a first controller carried in the housing of the first earbud and configured to perform functions comprising:

detecting attachment of the first charging adapter to the magnetic interface; and

based on detecting that the first charging adapter is attached to the magnetic interface, causing the first internal battery to charge from the first charging adapter, wherein charging the first internal battery

comprises drawing current from one or more adapter batteries of the first charging adapter via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter; and

the second earbud comprising:

a second IEEE 802.15-compatible interface;

a second internal battery;

a second audio driver;

a housing carrying the second IEEE 802.15-compatible interface and the second internal battery, wherein the housing of the second earbud comprises:

a first portion insertable into a second ear canal, the first portion carrying the second audio driver; and

a second portion carrying a magnetic interface that includes one or more magnets that (i) attach a second charging adapter externally to the housing of the second earbud and (ii) align electrodes of the second charging adapter to electrodes of the magnetic interface;

a second controller carried in the housing of the second earbud and configured to perform functions comprising:

detecting attachment of the second charging adapter to the magnetic interface; and

based on detecting that the second charging adapter is attached to the magnetic interface, causing the second internal battery to charge from the second charging adapter, wherein charging the second internal battery comprises drawing current from one or more adapter batteries of the second charging adapter via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

18. The pair of wireless earbuds of claim **17**, wherein:

the housing of the first earbud is formed to be carried within a first volume in a housing of a charging case while attached to the first charging adapter, wherein the electrodes of the first charging adapter contact first electrodes arranged in the housing of the charging case when the first charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the first charging adapter and the first internal battery of the first earbud charge from (a) one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter; and

the housing of the second earbud is formed to be carried within a second volume in the housing of the charging case while attached to the second charging adapter, wherein the electrodes of the second charging adapter contact second electrodes arranged in the housing of the charging case when the second charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the second charging adapter and the second internal battery of the second earbud charge from (a) the one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the second earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

19. The pair of wireless earbuds of claim **17**, wherein:

the housing of the first earbud is formed to be carried within a first volume in a housing of a charging case while attached to the first charging adapter, wherein the electrodes of the first charging adapter contact first electrodes arranged in the housing of the charging case when the first charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the first charging adapter and the first internal battery of the first earbud charge from (a) one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter; and

the housing of the second earbud is formed to be carried within a second volume in the housing of the charging case while attached to the second charging adapter, wherein the electrodes of the second charging adapter contact second electrodes arranged in the housing of the charging case when the second charging adapter is carried in the housing of the charging case, and wherein the one or more adapter batteries of the second charging adapter and the second internal battery of the second earbud charge from (a) the one or more case batteries of the charging case when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the second earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

20. The pair of wireless earbuds of claim **17**, wherein the first charging adapter and the second charging adapter are interchangeable between the first earbud and the second earbud.

21. The pair of wireless earbuds of claim **17**, wherein the first internal battery of the first earbud and the second internal battery of the second earbud are removeable, wherein the first charging adapter is swappable with the first internal battery, and wherein the second charging adapter is swappable with the second internal battery.

22. A charging case comprising:

one or more case batteries; and

a housing carrying the one or more case batteries, the housing comprising:

a first portion forming a first volume shaped to carry a first charging adapter and a first earbud when the first charging adapter and the first earbud are attached;

first electrodes arranged in the housing to contact electrodes of the first charging adapter when the first charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the first charging adapter and a first internal battery of the first earbud charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the first earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the first charging adapter;

a second portion forming a second volume shaped to carry a second charging adapter and a second earbud when the second charging adapter and the second earbud are attached; and

second electrodes arranged in the housing to contact electrodes of the second charging adapter when the second charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the second charging adapter and a second internal battery of the second earbud charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power, and wherein the second earbud draws current via the electrodes of the magnetic connection interface and the electrodes of the second charging adapter.

23. The charging case of claim **22**, further comprising:

a third portion forming a third volume shaped to carry a third charging adapter;

third electrodes arranged in the housing to contact electrodes of the third charging adapter when the third charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the third charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power;

a fourth portion forming a fourth volume shaped to carry a fourth charging adapter; and

fourth electrodes arranged in the housing to contact electrodes of the fourth charging adapter when the fourth charging adapter is carried in the housing of the charging case, wherein one or more adapter batteries of the fourth charging adapter charge from (a) the one or more case batteries when the charging case is disconnected from wall power or (b) wall power when the charging case is connected to wall power.

24. The charging case of claim **22**, wherein the charging case further comprises (i) one or more coils, wherein a wireless charger induces a current in the one or more coils to wirelessly charge the one or more case batteries from wall power connected to the wireless charger and (ii) a cable port, wherein a cable connected between the cable port and a wall charger delivers current to charge the one or more case batteries from wall power connected to the wall charger.

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